UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

Date:

Subject: **Thiamethoxam.** REVISED Occupational and Residential Exposure and Risk Assessment for the Existing Uses of Thiamethoxam for Registration Review

PC Code: 060109
Decision No.: 528261
Petition No.: NA
Risk Assessment Type: Occupational/Residential Exposure Assessment
TXR No.: NA
MRID No.: NA

DP Barcode: D441143
Regulatory Action: Registration Review
Case No.: 7614
CAS No.: 153719-23-4
40 CFR: §180.565

From: Kelly M. Lowe, Environmental Scientist
Risk Assessment Branch (RAB) 5/7
Health Effects Division (7509P)

Through: Christina Swartz, Branch Chief
RAB2
Health Effects Division (7509P)

and

Cassi Walls, ExpoSAC Reviewer
Monica Hawkins, ExpoSAC Reviewer
Exposure Science Advisory Committee (ExpoSAC) / HED

To: Thomas Harty
Neil Anderson, RM51
Risk Management and Implementation Branch I (RMIBI)
Pesticide Reevaluation Division (7508P)

Introduction

The Health Effects Division (HED) of the Office of Pesticide Programs (OPP) is charged with estimating the risk to human health from exposure to pesticides. As part of Registration Review, the Pesticide Re-evaluation Division (PRD) of OPP has requested that HED conduct an occupational and residential exposure assessment, as needed, to estimate the risk to human health that will result from the currently registered uses of thiamethoxam in support of registration

review for the chemical. This memorandum serves as HED's assessment of the occupational and residential exposure and risk from existing uses of thiamethoxam.

This document has been revised to reflect updates based on comments received during the public comment process. It supersedes D441143.

It is HED policy to use the best available data to assess exposure. Several sources of generic data were used in this assessment as surrogate data in the absence of chemical-specific data, including: Pesticide Handlers Exposure Database Version 1.1 (PHED 1.1); the Agricultural Handler Exposure Task Force (AHETF) database; the Outdoor Residential Exposure Task Force (ORETF) database; the Agricultural Reentry Task Force (ARTF) database; proprietary studies (MRIDs 45200002, 41054701, 44739301, 44339801, 45250702, 45167201); the Residential Standard Operating Procedures (SOPs) (indoor environments, gardens and trees, and lawns and turf); and ExpoSAC Policy 14, 15, and 15.1 (SOPs for Seed Treatment). This assessment also incorporates phase 2 of the AHETF seed treatment survey (MRID 49185401). Some of these data are proprietary, and subject to the data protection provisions of the *Federal Insecticide, Fungicide, and Rodenticide Act (*FIFRA).

Table of Contents

[TOC \o "1-3" \h \z \u]

1.0 Executive Summary

HED has conducted an occupational and residential exposure assessment for Registration Review of the registered uses of the active ingredient (ai), thiamethoxam. Thiamethoxam is a broad spectrum nitroguanidine insecticide which belongs to the pesticidal class of compounds known as the neonicotinoids (Group 4A; Insecticide Resistance Action Committee). It has activity against sucking and chewing insects. Thiamethoxam appears to interfere with the nicotinic acetylcholine receptors of the insect's nervous system, but the specific receptor site is unknown at this time.

This memorandum contains HED's occupational exposure and risk estimates to pesticide handlers (i.e., mixers, loaders, applicators) and residential handlers. This assessment also contains residential and occupational post-application assessments evaluating exposure to thiamethoxam resulting from existing registered uses. In addition, an assessment of non-occupational exposures resulting from spray drift was conducted.

Use Pattern

Thiamethoxam is currently registered for use on a variety of agricultural food crops (foliar and seed treatment), in livestock pens and poultry houses, on turf grass (including sod farms, golf courses, residential lawns, athletic fields), ornamental plants (grown in greenhouses, field nurseries, and residential/commercial landscapes), and Christmas trees. It is also registered for use as structural/perimeter control (indoors and outdoors in warehouses, schools, apartments, etc.), and in indoor environments for the control of bed bugs. Thiamethoxam is formulated as a liquid, microencapsulated liquid, gel, ready-to-use (RTU), wettable powder in water soluble bags (WSB), dust, dry flowable (DF), and granule. It may be applied to agricultural crops by ground, aerial and chemigation equipment; to turf/lawns, ornamentals, and indoor environments using handheld equipment; and to greenhouse ornamentals using automated foggers. Seed treatment can be done commercially or on-farm, and can be applied using open or closed systems.

Exposure Profile

For occupational use patterns, dermal and inhalation exposures are anticipated for occupational handlers and for post-application workers. Occupational handler and post-application exposure is expected to be both short- (1 to 30 days) and intermediate-term (1 to 6 months). For residential use patterns, dermal and inhalation exposures are anticipated for adult residential handlers, dermal post-application exposures are anticipated for adults and children (11 to <16, 6 to < 11 and 1 to < 2 years old), and incidental oral exposures and episodic ingestion of granules are anticipated for children (1 to < 2 years old). Residential handler and post-application exposure is expected to be short-term. Non-occupational exposures from spray drift (dermal and/or incidental oral) are expected to be short-term only.

The majority of occupational labels require baseline clothing (long sleeve shirt, long pants, socks and shoes), and some labels also require the use of additional personal protective equipment (PPE) such as gloves and protective eyewear. Several of the seed treatment labels require additional PPE, such as gloves, coveralls and respirators, and some indicate closed mixing/loading systems are required. There are also labels intended for consumer use that do not have any clothing or PPE requirements listed. Most thiamethoxam labels include a restricted

entry interval (REI) of 12 hours; some include a REI of 48 hours, but all of those labels are multiple active ingredient products. Several seed treatment labels were identified as restricted use pesticides (RUPs); however, all of those product labels are multiple active ingredient products.

Hazard Characterization

The toxicological database for thiamethoxam is complete and acceptable for selecting toxicity endpoints and points of departure (PODs) for risk assessment. An inhalation toxicity study is not available for thiamethoxam; however, the Hazard and Science Policy Council (HASPOC) recommended, based on a weight-of-evidence (WOE) approach, that the study is not required (TXR# 0057630). In acute lethality studies, technical thiamethoxam is slightly toxic to rats and moderately toxic to mice via the oral route of exposure (Toxicity Category III); it is of low toxicity to rats via the dermal (Toxicity Category III) and inhalation routes (Toxicity Category IV). It is not irritating to the skin and minimally irritating to the eye, and is not a dermal sensitizer.

The point of departure (POD) used for assessing episodic ingestion of granules for children 1 to <2 years old was selected from a developmental neurotoxicity study in the rat, where the no observed adverse effect level (NOAEL) was 34.5 mg/kg/day. The level of concern (LOC) is 100 based on 10x for inter-species extrapolations, 10x for intra-species variations, and a 1x Food Quality Protection Act Safety Factor (FQPA SF). The POD used for assessing short-term incidental oral exposure was selected from the 28-day oral toxicity study in the dog, where the NOAEL is 31.6 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The POD used for assessing dermal and inhalation exposure for adults was selected from two co-critical 2-generation reproduction studies in the rats, where the offspring NOAEL is 1.2 mg/kg/day (MRID 46402904; 2004 study), and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The POD used for assessing dermal exposure to children <6 years of age was selected from the 28-day dermal study in rats, where the NOAEL is 60 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The POD used for assessing short-term inhalation exposure to children <6 years of age was selected from the 28-day oral toxicity study in the dog, where the NOAEL is 31.6 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). Thiamethoxam is classified as "not likely to be carcinogenic to humans."

Since the toxicological effects are similar for the dermal and inhalation routes, the dermal and inhalation risks to adult are combined. Since the LOC for dermal and inhalation risks are the same, a total margin of exposure (MOE) is calculated. For children, the incidental oral, inhalation, and dermal routes of exposure do have a common effect, therefore, the exposures from those routes can also be combined.

Residential Exposure and Risk Assessment

Thiamethoxam is currently registered for a number of residential use sites. Combined (dermal and inhalation) residential handler risk estimates are not of concern (i.e., MOE ≥ LOC of 100) for all scenarios.

For the residential post-application assessments, chemical-specific dislodgeable foliar residue (DFR) and turf transferable residue (TTR) are available and were used. Post-application inhalation, dermal, and/or incidental oral MOEs were not of concern for treatments in the indoor environment for adults (MOEs range from 230 to 130,000,000) and children 1 to <2 years old (MOEs range from 700 to 940,000,000). Similarly, dermal and/or incidental oral MOEs for treatments to lawns/turf and ornamentals were not of concern for adults (MOEs range from 180 to 28,000), children 11 to <16 years old (MOEs range from 7,400 to 29,000), children 6 to <11 years old (MOEs range from 310 to 6,300), and children 1 to <2 years old (MOEs range from 850 to 3,500,000). Additionally, episodic granule ingestion risk estimates were not of concern (MOE = 630).

Non-Occupational Spray Drift Exposure

A quantitative spray drift assessment for thiamethoxam is not required because the maximum application rate to a crop/target site multiplied by the adjustment factor for drift of 0.26 is less than the maximum direct spray residential turf application rate for any thiamethoxam products. The turf post-application MOEs have been assessed, are based on the revised SOPs for Residential Exposure Assessment, and are not of concern.

Occupational Exposure and Risk Assessment

For the *foliar uses* of thiamethoxam, the majority of the occupational handler combined (dermal and inhalation) risk estimates did not result in risk estimates of concern (MOEs ≥ 100) with baseline attire. Of the 91 total occupational handler exposure scenarios assessed, 80 scenarios are not of concern (i.e., total MOEs ≥ 100) with baseline attire consisting of long-sleeved shirt, long pants, and shoes plus socks (or engineering controls for aerial applications). Of the remaining 11 handler exposure scenarios, all are not of concern with consideration of increasing levels of dermal and respiratory protection. Eight of those scenarios only require the addition of gloves to reach acceptable MOEs, and all labels reviewed already included a requirement for gloves to be worn; therefore, 3 scenarios require mitigation above what is currently on the registered labels to reach acceptable MOEs.

For the *seed treatment uses* of thiamethoxam, when using an open loading system for commercial seed treatment, there are only a few scenarios that do not reach acceptable combined (dermal + inhalation) MOEs (i.e., MOEs ≥ 100) assuming a worker is wearing a single layer of clothing, gloves and no respirator (the lowest level of clothing and PPE on some seed treatment labels). Several of these scenarios reach acceptable MOEs (i.e., MOEs ≥ 100) with additional PPE such as coveralls (i.e., a double layer of clothing) and/or a respirator. For some scenarios, MOEs are still not above the LOC of 100 even with maximum PPE (combined dermal + inhalation MOEs range from 64 to 97). These uses include seed treatment for corn (pop and sweet). It should be noted some labels reviewed for these particular seed treatment uses included requirements for treaters and/or multiple activity workers to wear coveralls (considered a double layer of clothing) and in some cases a respirator.

When using a closed loading system for commercial seed treatment, there are no risk estimates of concern (combined dermal + inhalation) for all seed treatment worker activities (this assumes workers are wearing a double layer of clothing and no respirator as this is representative of clothing worn in the exposure study on which the unit exposures are based).

For on-farm seed treatment, there are no risk estimates of concern (combined dermal + inhalation) for all seed treatment workers assuming they are wearing a single layer of clothing and no respirator.

For seed planters, there are no risk estimates of concern.

For the occupational post-application assessments for the foliar uses of thiamethoxam, chemical-specific DFR and TTR data are available and were used. All of the dermal post-application exposure scenarios resulted in MOEs greater than the LOC (MOE ≥ 100) on the day of application and are not of concern (MOEs range from 100 to 5,300). Based on the Agency's current practices, a quantitative occupational post-application inhalation exposure assessment was not performed for re-entry workers exposed to indirect residues of thiamethoxam resulting from outdoor uses.

Human Studies Review

This risk assessment relies in part on data from studies in which adult human subjects were intentionally exposed to a pesticide or other chemical. These data, which include studies from PHED 1.1; the AHETF database; the ORETF database; proprietary studies (MRIDs 45200002, 41054701, 44739301, 44339801, 45250702, 45167201); the ARTF database; ExpoSAC Policy 14 (SOP for Seed Treatment); the Residential SOPs (indoor environments, gardens and trees, lawns and turf), are (1) subject to ethics review pursuant to 40 CFR 26, (2) have received that review, and (3) are compliant with applicable ethics requirements. For certain studies, the ethics review may have included review by the Human Studies Review Board. Descriptions of data sources, as well as guidance on their use, can be found at the Agency website[1].

[1] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data and https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-post-application-exposure

2.0 Risk Assessment Conclusions and Recommendations

2.1 Summary of Risk Estimates

- None of the residential handler risk estimates are of concern. Residential post-application risk estimates are not of concern for the registered uses of thiamethoxam.
- For the foliar uses of thiamethoxam, the majority of occupational handler scenarios are not of concern with baseline level of clothing; however, there are several that require PPE in order to reach MOEs that are not of concern. In many cases, MOEs are not of concern when gloves are considered which are already required on most labels. Three scenarios require mitigation above what is currently on the registered labels to reach acceptable MOEs.
- For the seed treatment uses of thiamethoxam, there are some commercial seed treatment open loading scenarios that are of concern even with maximum PPE (i.e., double layer of clothing and respirators). These uses include seed treatment for corn (pop and sweet). It should be noted that some labels reviewed for these particular seed treatment uses included requirements for treaters and/or multiple activity workers to wear coveralls (considered a double layer of clothing) and in some cases a respirator, but not all did. For commercial seed treatment closed loading systems, on-farm seed treatment and loader/planter scenarios, there are no risk estimates of concern.
- None of the occupational post-application scenarios for the foliar uses of thiamethoxam are of concern on the day of application.

2.2 Label Recommendations from Occupational Assessment

No specific recommendations are being made; however, HED has identified some risk estimates of concern for occupational handlers. Some of these risk estimates are not of concern with the addition of PPE beyond what is currently on labels, such as coveralls and/or respirators.

2.3 Label Recommendations from Residential Assessment

None.

2.4 Data Deficiencies and Requirements

None.

3.0 Hazard Characterization

Acute Toxicity

In acute lethality studies, technical thiamethoxam is slightly toxic to rats and moderately toxic to mice via the oral route of exposure (Toxicity Category III); it is of low toxicity to rats via the dermal (Toxicity Category III) and inhalation routes (Toxicity Category IV). It is not irritating to the skin and minimally irritating to the eye, and is not a dermal sensitizer. A summary of the acute toxicity profile is provided in Table 3.1 below.

Table 3.1. Acute Toxicity Profile – Thiamethoxam.			
Guideline No./Study Type	MRID No.	Results	Toxicity Category
870.1100/Acute Oral - rat	44703314	LD_{50}: 1563 mg/kg (♂+♀)	III
870.1200/Acute Dermal	44703316	LD_{50} > 2000 mg/kg (♂+♀)	III
870.1300/ Acute Inhalation	44703317	LC_{50} > 3.72 mg/L (♂+♀)	IV
870.2400/ Primary Eye Irritation	44703318	Minimally irritating	IV
870.2500/ Primary Skin Irritation	44703319	Not irritating	IV
870.2600/ Dermal Sensitization	44710401	Is not a sensitizer using method of Magnusson and Kligman	N/A

Toxicological PODs Used for Risk Assessment

The toxicological database for thiamethoxam is complete and acceptable for selecting toxicity endpoints and PODs for risk assessment. An inhalation toxicity study is not available for thiamethoxam; however, the HASPOC recommended, based on a WOE approach, that the study is not required (TXR# 0057630).

No new toxicity data have been received for thiamethoxam since the previous risk assessment (D425511, D. McNeilly et. al., 7/2/2015). All endpoints remain the same as the previous risk assessment, except for incidental oral and inhalation exposure. HED updated the point of departure for the incidental oral assessment (from the 90 day dog study to the 28 day dog study) and chose an inhalation endpoint specific for children <6 years old.

Acute Dietary Endpoint (used for episodic ingestion): The endpoint used for establishing the acute dietary POD was selected from the developmental neurotoxicity study in the rat, where the NOAEL is 34.5 mg/kg/day. The LOC is 100, which includes 10x for inter-species extrapolations, 10x for intra-species variations, and a 1x Food Quality Protection Act (FQPA) Safety Factor (SF). The LOAEL of 298.7 mg/kg/day was based on decreased body weight and reduced brain morphometric measurements.

Incidental Oral (short-term): The endpoint used for assessing short-term incidental oral exposure was selected from the 28-day oral toxicity study in the dog. The NOAEL is 31.6 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The effects observed at the LOAEL of 43.0 mg/kg/day were decreased body weight, changes in hematopoietic and clinical chemistry parameters, and histopathological changes in the liver, thymus, and spleen.

Dermal – Adults (short- and intermediate-term): The endpoint used for establishing the dermal exposure for adults was selected from two co-critical 2-generation reproduction studies in the rats. The offspring NOAEL is 1.2 mg/kg/day (MRID 46402904; 2004 study), and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The offspring LOAEL of 1.8 mg/kg/day (MRID 44718707; 1998 study) was based on testicular effects in the F_1 males. The NOAEL from this study was 0.6 mg/kg/day; however, the dose of 1.2 mg/kg/day from the second 2-generation reproduction study was used as the NOAEL based on the fact that there was no effect on the testes at this dose (testes effects in this study were seen at 156 mg/kg/day). The NOAEL of 1.2 mg/kg/day from the 2004 study is considered protective of the effects observed at the LOAEL of 1.8 mg/kg/day in the 1998 study because the testes effects observed in the 1998 study were considered conservative based on the marginal nature of

the effect at the LOAEL and the effects were not corroborated in the other studies in the database. However, the Agency concluded that the LOAEL for testes effect in the 2004 study could be used over the 1998 study, primarily because the two studies used different terminology, criteria, and scoring for the histopathological evaluation leading to uncertainty in comparing the results across studies.

Although a 28-day dermal toxicity study in rats is available, HED selected a reproductive NOAEL to protect for the effects observed in the reproduction study that were not evaluated in the dermal toxicity study.

Dermal – Children <6 years (short-term): The endpoint used for assessing dermal exposure to children <6 years of age was selected from the 28-day dermal study in rats. The NOAEL is 60 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The LOAEL of 250 mg/kg/day is based on increased plasma glucose, triglyceride levels, and alkaline phosphatase activity as well as inflammatory cell infiltration in the liver and necrosis of single hepatocytes in females. HED selected the dermal toxicity study to assess young children because the testicular effects observed in the two-generation rat reproduction study are not relevant for young children that are sexually immature.

Inhalation –Adults (short- and intermediate-term): The endpoint used for assessing inhalation exposure to adults was selected from two co-critical 2-generation reproduction studies in the rats. The NOAEL is 1.2 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The effects observed and the LOAELs have been described above (see dermal - adults). These studies were selected because of the exposure duration, and because the endpoint (testicular effects) is protective of all other effects in the database. No route-specific repeat dose study is available to assess for potential inhalation toxicity resulting from thiamethoxam exposure. In the absence of a route-specific study, the NOAEL and LOAEL from an oral study have been used for risk assessment.

Inhalation – Children <6 years (short-term): The endpoint used for assessing short-term inhalation exposure to children <6 years of age was selected from the 28-day oral toxicity study in the dog. The NOAEL is 31.6 mg/kg/day, and the LOC is 100 (10x for inter-species extrapolation, 10x for intra-species variability, and a 1x FQPA SF). The effects and LOAEL have been described above (see incidental oral). The study, dose, and endpoint were selected because the study is of the appropriate duration and is protective of all offspring effects in the reproduction and developmental studies. HED selected the 28-day dog study to assess young children because the testicular effects observed in the two-generation rat reproduction study are not relevant for young children that are sexually immature. No route-specific information is available for the inhalation toxicity of thiamethoxam. In the absence of a route-specific study, the NOAEL and LOAEL from an oral study have been used for risk assessment.

Thiamethoxam is classified as "not likely to be carcinogenic to humans."

A summary of the toxicological doses and endpoints is provided in Table 3.2.

Table 3.2. Summary of Toxicological Doses and Endpoints for Thiamethoxam for Use in Human Health Risk Assessments.				
Exposure/ Scenario	**Point of Departure**	**Uncertainty/ FQPA Safety Factors**	**Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Acute Dietary (used for episodic ingestion of granules) All populations including infants and children	NOAEL = 34.5 mg/kg/day	UF_A= 10x UF_H= 10x FQPA SF=1	MOE= 100 (residential)	**Rat Developmental Neurotoxicity study** LOAEL = 298.7 mg/kg/day based on decreased body weight and reduced brain morphometric measurements.
Incidental Oral (Short-term)	NOAEL= 31.6 mg/kg/day	UF_A= 10x UF_H= 10x FQPA SF =1	MOE= 100 (residential)	**28-day Dog study (MRID 44703324)** LOAEL = 47.7/43.0 (M/F) mg/kg/day based on body weight loss; leukopenia and increased hematocrit, hemoglobin and erythrocyte count; increased plasma urea and creatinine; reduced thymus weight in males and females, increased thyroid weight in males and reduced brain weight in females; and, histopathological changes in liver, thymus and spleen.
Dermal (Short-term) (Adults)	Oral study NOAEL= 1.2 mg/kg/day (MRID 46402904) (Dermal Absorption = 5%)	UF_A= 10x UF_H= 10x FQPA SF =1	MOE= 100 (residential and occupational)	**2-Generation reproduction study; 1998. (MRID 44718707)** LOAEL = 1.8 mg/kg/day based on increased incidence and severity of tubular atrophy in testes of F_1 generation males. **2-Generation reproduction study; 2004. (MRID 46402904)** LOAEL = 156 mg/kg/day (males), not determined (females) based on sperm abnormalities and germ cell loss in F_1 males.
Dermal (Short-term) (infants/ children <6 yrs)	Dermal Study NOAEL=60 mg/kg/day	UF_A= 10x UF_H= 10x FQPA SF =1	MOE= 100 (residential)	**Rat 28-Day Dermal Toxicity Study (MRID 44710402)** LOAEL = 250 (females) mg/kg/day based on increased plasma glucose, triglyceride levels, and alkaline phosphatase activity and inflammatory cell infiltration in the liver and necrosis of single hepatocytes in females.
Inhalation (Short-term) (Adults)	Oral study NOAEL= 1.2 mg/kg/day (MRID 46402904) (inhalation toxicity = oral toxicity)	UF_A= 10x UF_H= 10x FQPA SF =1x	MOE= 100 (residential and occupational)	**2-Generation reproduction study (MRID 44718707)** LOAEL = 1.8 mg/kg/day based on increased incidence and severity of tubular atrophy in testes of F_1 generation males. **2-Generation reproduction study (MRID 46402904)** LOAEL = 156 mg/kg/day (males), not determined (females) based on sperm abnormalities and germ cell loss in F_1 males.

Table 3.2. Summary of Toxicological Doses and Endpoints for Thiamethoxam for Use in Human Health Risk Assessments.				
Exposure/ Scenario	**Point of Departure**	**Uncertainty/ FQPA Safety Factors**	**Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Inhalation (Short-term) (infants/ children <6 yrs)	NOAEL= 31.6 mg/kg/day (inhalation toxicity = oral toxicity)	UF_A= 10x UF_B= 10x FQPA SF =1x	MOE= 100 (residential)	**28-day Dog study (MRID 44703324)** LOAEL = 47.7/43.0 (M/F) mg/kg/day based on body weight loss; leukopenia and increased hematocrit, hemoglobin and erythrocyte count; increased plasma urea and creatinine; reduced thymus weight in males and females, increased thyroid weight in males and reduced brain weight in females; and, histopathological changes in liver, thymus and spleen.
Cancer (oral, dermal, inhalation)	**"Not Likely to be Carcinogenic to Humans"** based on convincing evidence that a non-genotoxic mode of action for liver tumors was established in the mouse. Quantification of cancer risk is not required.			

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. UF = uncertainty factor. UF_A = extrapolation from animal to human (interspecies). UF_H = potential variation in sensitivity among members of the human population (intraspecies). FQPA SF = FQPA Safety Factor. MOE = margin of exposure. LOC = level of concern. N/A = not applicable.

Absorption

A dermal absorption factor of 5% was applied to adult occupational and residential dermal exposures. HED recommends use of a 5% dermal absorption factor for risk assessment based on a weight of the evidence approach considering the following:1) both *in vivo* dermal absorption studies support that the dose remaining at the skin site is not available for continued absorption over time, 2) the highest percentage of dermal absorption across both *in vivo* rat studies was 4.22%, which is likely a conservative estimate due to the potential for oral exposure in that study, 3) the physical chemical properties (Log Kow <1) support a low dermal absorption, and 4) the NIOSH finite dose skin permeation calculator supports that dermal absorption is negligible in humans.

Since the short-term dermal POD for infants/children <6 yrs old is based on a route-specific toxicity study, no absorption factor was needed to estimate exposure to infants/ children <6 yrs. Since no inhalation absorption data are available, toxicity by the inhalation route is considered to be equivalent to the estimated toxicity by the oral route of exposure.

Body Weight

Since the dermal and inhalation PODs are based on developmental and/or fetal effects, the body weight used for dermal and inhalation assessments is 69 kg. For children 11 to <16, children 6 to <11, and children 1 to <2 years old, body weights of 57, 32 and 11 kg were used, respectively.

4.0 Use Profile

Thiamethoxam is currently registered for use on a variety of agricultural food crops (foliar and seed treatment), in livestock pens and poultry houses, on turf grass (including sod farms, golf courses, residential lawns, athletic fields), ornamental plants (grown in greenhouses, field nurseries, and residential/commercial landscapes), and Christmas trees. It is also registered for use as a structural/perimeter control (indoor and outdoor in warehouses, schools, apartments,

etc.), and in indoor environments for the control of bed bugs. Thiamethoxam is formulated as a liquid, microencapsulated liquid, gel, ready-to-use (RTU), wettable powder in WSB, dust, DF, and granule. It may be applied to agricultural crops by ground, aerial and chemigation equipment; to turf/lawns, ornamentals, and indoor environments using handheld equipment; and to greenhouse ornamentals using automated foggers. Seed treatment can be done commercially or on-farm, and can be applied using open or closed systems.

The majority of occupational labels require baseline clothing (long sleeve shirt, long pants, socks and shoes), and some labels also require the use of additional PPE such as gloves and protective eyewear. Several of the seed treatment labels require additional PPE, such as gloves, coveralls and respirators, and some indicate closed mixing/loading systems are required. There are also labels intended for consumer use that do not have any clothing or PPE requirements listed. Most thiamethoxam labels include a REI of 12 hours; some include a REI of 48 hours, but all of those labels are multiple active ingredient products. Several seed treatment labels were identified as RUPs; however, all of those product labels are multiple active ingredient products.

A summary of the representative registered commercial end-use products and use sites with the highest application rates or percent ai is provided in Appendix A for the agricultural uses, non-agricultural and residential uses, and seed treatment uses of thiamethoxam. This summary has been compiled based primarily on the Biological and Economic Analysis Division's (BEAD's) HED Master Label Report and a review of several labels identified in that report.

5.0 Residential Exposure and Risk Estimates

There are no new residential uses at this time; however, there are existing residential uses which were previously assessed and reflect updates to HED's 2012 Residential SOPs[2] along with a revision to the inhalation POD for children ≤ 6 years of age (D359207, M. Collantes, July 24, 2009; and D406746, M. Crowley, Dec. 4, 2012). These exposures have been updated herein to reflect updated application rates and scenarios. Only those product labels without clothing and/or PPE requirements have been assessed for residential handler exposure.

5.1 Residential Handler Exposure/Risk Estimates

HED uses the term "handlers" to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct tasks related to applications and that exposures can vary depending on the specifics of each task. Residential handlers are addressed somewhat differently by HED as homeowners are assumed to complete all elements of an application without use of any protective equipment.

The registered thiamethoxam product labels for use on gardens/trees and lawns/turf do not require specific clothing (e.g., long sleeve shirt/long pants) and/or PPE, and these labels have been considered in the residential handler assessment for thiamethoxam. The quantitative exposure/risk assessment developed for residential handlers is based on the scenarios listed in Table 5.1.1.

[2] Available: http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

Application Rate: The registered application rates of thiamethoxam included in the quantitative exposure/risk assessment developed for residential handlers are based on the scenarios listed in Appendix Table A.2.

Unit Exposures and Area Treated or Amount Handled: Unit exposure values and estimates for area treated or amount handled were taken from HED's 2012 Residential SOPs.

Exposure Duration: Residential handler exposure is expected to be short-term in duration. Intermediate-term exposures are not likely because of the intermittent nature of applications by homeowners.

Residential Handler Non-Cancer Exposure and Risk Estimate Equations
The algorithms used to estimate exposure and dose for residential handlers can be found in the 2012 Residential SOPs and Appendix B of this document.

Combining Exposures/Risk Estimates:
Dermal and inhalation risk estimates were combined in this assessment, since the toxicological effects for these exposure routes were similar. Dermal and inhalation risk estimates were combined using the following formula:

[SEQ CHAPTER \h \r 1] *Total MOE = Point of Departure (mg/kg/day) ÷ Combined Dermal + Inhalation dose (mg/kg/day)*

Summary of Residential Handler Non-Cancer Exposure and Risk Estimates
As shown below in Table 5.1.1, combined dermal and inhalation risk estimates for residential handlers were not of concern (MOE ≥LOC of 100) for all scenarios.

Table 5.1.1. Residential Handler Non-cancer Exposure and Risk Estimates for Existing Residential Uses of Thiamethoxam.

Formulation (Representative EPA Reg. #)	Equipment	Maximum Application Rate[1]	Area Treated or Amount Handled Daily[2]	Dermal Unit Exposure (mg/lb ai)	Inhalation Unit Exposure (mg/lb ai)	Dose (mg/kg-day)		MOE (LOC = 100)		
						Dermal[3]	Inhalation[5]	Dermal[4]	Inhalation[6]	Total[7]
Gardens/Trees										
Liquid (100-1367)	Hose-end Sprayer	0.001 lb ai/gal	11 gal	58	0.0014	0.00046	0.00000022	2,600	5,400,000	2,600
RTU (100-1366)	Trigger-spray bottle	0.00016 lb ai/bottle	2 bottles	85.1	0.061	0.00002	0.00000028	61,000	4,200,000	60,000
DF (100-943)	Manually-pressurized handwand	0.0041 lb ai/gal	5 gal	69	1.1	0.001	0.00033	1,200	3,700	890
Granule (100-961)	Push-type rotary spreader	6.10E-06 lb ai/ft^2	1200 ft^2	0.81	0.0026	0.0000043	0.00000028	280,000	4,400,000	260,000
Microencapsulated (100-1436)	Manually-pressurized handwand	0.0011 lb ai/gal	5 gal	63	0.018	0.00025	0.0000014	4800	840,000	4,800
	Hose-end Sprayer	0.0011 lb ai/gal	11 gal	58	0.0014	0.00051	0.00000025	2400	4,900,000	2,400
	Backpack	0.0011 lb ai/gal	5 gal	130	0.14	0.00052	0.000011	2300	110,000	2,300
Lawns/Turf										
WDG (100-943)	Manually-pressurized handwand	0.004 lb ai/gal	5 gal	69	1.1	0.00012	0.00037	1,200	3,800	910
	Manually pressurized handwand (ant mounds)	0.0047 lb ai/gal	5 gal	69	1.1	0.0012	0.00037	1,000	3,200	770
	Backpack	0.004 lb ai/gal	5 gal	69	1.1	0.00012	0.00037	1,200	3,800	910

1 Based on registered labels.
2 Based on HED's 2012 Residential SOPs (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide).
3 Dermal Dose = Dermal Unit Exposure (mg/lb ai) × Application Rate (lb ai/gal, bottle or ft^2) × Area Treated or Amount Handled × Dermal Absorption Factor (5%) ÷ Body Weight (69 kg).
4 Dermal MOE = Dermal NOAEL (1.2 mg/kg/day) ÷ Dermal Dose (mg/kg/day).
5 Inhalation Dose = Inhalation Unit Exposure (mg/lb ai) × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A/day or gallons/day) ÷ Body Weight (69 kg).
6 Inhalation MOE = Inhalation NOAEL (1.2 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).
7 Total MOE = NOAEL (1.2 mg/kg/day) ÷ (Dermal Dose mg/kg/day + Inhalation Dose mg/kg/day)

5.2 Residential Post-application Exposure/Risk Estimates

There is the potential for post-application exposure for individuals exposed as a result of being in an environment that has been previously treated with thiamethoxam. The quantitative exposure/risk assessments for residential post-application exposures are based on the scenarios listed in Table 5.2.1.

Post-application exposure has been assessed only for liquid and granular applications to turf, gardens/trees, and indoor environments (carpets and hard floor). Post-application dermal and inhalation exposures for foundation, perimeter, and spot treatments outdoors is anticipated to be negligible due to the unlikely occurrence of adults and children utilizing the area. Furthermore, post-application inhalation exposures outdoors for the scenarios considered in this assessment (turf and gardens/trees) are considered negligible as a result of dissipation of residues over time.

The lifestages selected for each post-application scenario are based on an analysis provided as an Appendix in the 2012 Residential SOPs[3]. While not the only lifestage potentially exposed for these post-application scenarios, the lifestage that is included in the quantitative assessment is health protective for the exposures and risk estimates for any other potentially exposed lifestage.

Residential Post-application Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the residential post-application risk assessment. Each assumption and factor is detailed in the 2012 Residential SOPs[NOTEREF _Ref332713314 \h * MERGEFORMAT].

Application Rate: The registered application rates of thiamethoxam on ornamentals, residential turf, golf courses, and indoor surfaces are listed in Appendix Table A.2 (includes both occupational handler uses for residential sites and residential handler uses).

Exposure Duration: Residential exposure is expected to be short-term in duration. Intermediate-term exposures are not likely because of the intermittent nature of applications by homeowners. Ingestion of granules is considered an episodic event and not a routine behavior. Because HED does not believe that this would occur on a regular basis, the concern for human health is related to acute poisoning rather than short-term residue exposure. Therefore, an acute dietary POD is used to estimate risk resulting from episodic ingestion of granules.

Dislodgeable Foliar Residue (DFR) Data: A DFR study is available for thiamethoxam (MRID 46039901, D441508). A small scale greenhouse trial was conducted as a pilot study to determine the level of residues of thiamethoxam dislodged from hydrangea plant foliage under actual greenhouse conditions immediately after one application of Flagship 25™ WG at the proposed maximum label rate of 8.5 oz formulated product per acre (0.133 lb ai/A). The field trial greenhouses were located at a research facility near Creedmoor, North Carolina. The test product used in the study was Flagship™ 25WG, a water-dispersible granule containing 25% thiamethoxam as the active ingredient (ai). The test product was applied to the foliage in a single

[3] Available: http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

directed spray application using a single nozzle low pressure hand gun sprayer. Triplicate DFR samples were collected from the treated ornamental plants following the application. Control samples were collected from ornamental plants in a greenhouse located nearby in which no Flagship™ 25WG applications were made. Samples were collected from treated replicate plots A, B, and C, prior to and following the application (2-hours) and at 4, 8, 12, and 24 hours after the application. Control leaf punch samples were collected before the application, following the application (2 hours) and 24 hours after the application. The thiamethoxam DFR values did not vary much in the first 12 hour sampling period, and the value at 24 hours, the last sampling period, were slightly lower. The highest average residue was observed 12-hours after the application (0.238 µg/cm^2). The average residue at 24 hours after application was 0.155 µg/cm^2. The predicted DAT-0 residue value of 0.243 µg/cm^2 was used to assess post-application exposure following applications to residential ornamentals. The predicted DAT-0 residue value was adjusted to account for the maximum registered ornamental application rate, where the maximum registered application rate is 0.266 lb ai/A (adjusted DFR value = 0.486 ug/cm^2).

Summary of DFR Values from a Dry Flowable Formulation application to Greenhouse Ornamentals with Thiamethoxam; MRID# 46039901 (Pilot Study).

	Greenhouse located in North Carolina
Study Rate (lb ai/A)	0.133
Spray Volume (GPA)	~200
Measured Average Day 0 Residue (µg/cm^2)	0.235
Predicted Day 0 Value (µg/cm^2)	0.243
Slope	-0.408
R^2	0.594
Half-life	1.7

Turf Transferable Residue (TTR) Data: A TTR study is available for thiamethoxam (MRID 46402915, D321327). The TTR study was conducted at individual sites in California, North Carolina, and Pennsylvania using a modified California roller technique. Two formulations of thiamethoxam, a sprayable wettable granule (Meridian™ 25WG Insecticide) containing 25% of the active ingredient (a.i.) and a dry granular (Meridian™ 0.33G Insecticide) containing 0.33% of the a.i. were tested at a target application rate of 0.265 lb ai/A. Each field site consisted of four treated plots: (1) WG, non-irrigated; (2) WG, irrigated; (3) granular, non-irrigated; and (4) granular, irrigated. TTRs were sampled immediately before and after each application (non-irrigated plots only); at 4, 8, and 24 hours after treatment, and 2, 4, 7, 10, 14, and 21 days after treatment.

No detectable TTRs were observed at plots treated with the granular formulation, irrigated or non-irrigated. Only one irrigated 25WG plot (North Carolina) had measurable transferable residues; these residues were detected at 4 hours and 2 days after treatment. At all other locations, irrigated 25WG plots had no detectable residues of thiamethoxam.

Thiamethoxam transferable residues were detected at all sites in the non-irrigated 25WG

plots. The highest average initial residues occurred immediately following application, averaging 0.012 µg/cm^2 at the California site, 0.0096 µg/cm^2 at the Pennsylvania site, and 0.0074 µg/cm^2 at the North Carolina site. The predicted DAT-0 residue value of 0.0105 µg/cm^2 from the California site was used to estimate post-application exposures following applications to turf, as this site showed slower residue dissipation compared to the PA site (which had a predicted day 0 residue value of 0.0108 ug/cm^2). The predicted DAT-0 residue value was adjusted to account for the maximum registered turf application rate where the maximum registered application rate is 0.266 lb ai/A (adjusted TTR value = 0.0106 ug/cm^2).

Summary of TTR Values from a Dry Flowable Formulation application to Turf for Thiamethoxam; MRID# 46402915.

	North Carolina	Pennsylvania	California
Study Rate (lb ai/A) Plot 1	0.270	0.277	0.265
Spray Volume (GPA) Plot 1	84.5	84.9	80
Measured Average Day 0 Residue (µg/cm^2)	0.0074	0.0096	0.012
Predicted Day 0 Value (µg/cm^2)	0.007	0.0108	0.0105
Slope	-0.497	-1.949	-0.587
R^2	0.7044	0.9745	0.991
Half-life	1.4	0.4	1.2

Residential Post-Application Non-Cancer Exposure and Risk Equations

The algorithms used to estimate residential post-application exposures and doses can be found in the 2012 Residential SOPs[4] and in Appendix B of this document.

Combining Exposure and Risk Estimates

The dermal and incidental oral routes share a common effect, and therefore, the exposures from those routes have been combined. The incidental oral scenarios (i.e., hand-to-mouth and object-to-mouth) should be considered inter-related and it is likely that they occur interspersed amongst each other across time. Combining these scenarios with the dermal exposure scenario would be overly-conservative because of the conservative nature of each individual assessment. Therefore, the post-application exposure scenarios that were combined for children 1 < 2 years old are the dermal and hand-to-mouth scenarios. This combination should be considered a protective estimate of children's exposure.

Characterization of Granule Ingestion

Ingestion of granules is considered an episodic event and not a routine behavior. Because HED does not believe that this would occur on a regular basis, the concern for human health is related to acute exposure rather than short-term exposure. Therefore, an acute dietary POD is used to estimate exposure and risk resulting from episodic ingestion of granules.

[4] http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

Summary of Residential Post-application Non-Cancer Exposure and Risk Estimates

None of the residential post-application exposures resulted in risk estimates of concern (i.e., all MOEs ≥ 100). Since there were no detectable residues for the granular formulation on turf, a quantitative assessment was not conducted for that formulation for the turf scenarios, and the liquid formulation assessment is considered protective of any potential exposure.

Table 5.2.2. Residential Post-application Non-cancer Exposure and Risk Estimates for Thiamethoxam.

Lifestage	Post-application Exposure Scenario		Amount Applied/ Residue[a]	Dose (mg/kg/day)[b]	MOEs[c]	Combined Routes (X indicates included in Total MOE)	Total MOE (LOC = 100)[d]
	Application Type	Route of Exposure					
Indoor Environment							
Adult	Indoor Surface Direct Spray Perimeter/Spot/Bedbug (coarse and pinstream)	Dermal-carpet	Deposited residue (µg/cm²) = 2.19[f]	0.0052	230	X	230
		Dermal-hard surface		0.0017	700		
		Inhalation	Mass of ai applied (mg) = 2,020[e]	0.000000009	1.30E+08	X	
Child 1 to <2 years		Dermal-carpet	Deposited residue (µg/cm²) = 2.19[f]	0.086	700	X	540
		Dermal-hard surface		0.057	1,000		
		Inhalation	Mass of ai applied (mg) = 2,020[e]	0.000000034	9.40E+08	X	
		Hand to Mouth- carpet	Deposited residue (µg/cm²) = 2.19[f]	0.013	2,400	X	
		Hand to Mouth- hard surface		0.0043	7,300		
		Object to Mouth-carpet		0.0017	18,000		
		Object to Mouth- hard surface		0.0011	28,000		
Adult	Indoor Surface Direct Sprays Crack and crevice	Dermal-carpet	Deposited residue (µg/cm²) = 0.44[g]	0.0010	1,200	X	1,200
		Dermal-hard surface		0.00035	3,500		
		Inhalation	Mass of ai applied (mg) = 2,020[e]	0.000000009	1.30E+08	X	
Child 1 to <2 years		Dermal-carpet	Deposited residue (µg/cm²) = 0.44[g]	0.017	3,500	X	2,700
		Dermal-hard surface		0.011	5,200		
		Inhalation	Mass of ai applied (mg) = 2,020[e]	0.000000034	9.40E+08	X	
		Hand to Mouth- carpet	Deposited residue (µg/cm²) = 0.44[g]	0.0026	12,000	X	
		Hand to Mouth- hard surface		0.00086	37,000		
		Object to Mouth-carpet		0.0003	92,000		
		Object to Mouth- hard surface		0.0002	140,000		
Lawns and Turf							
Adult	High Contact Lawn Activities	Dermal -Liquid	TTR (µg/cm²) = 0.0106[h]	0.0021	580		
	Mowing Turf	Dermal -Liquid		4.2-05	28,000		

Table 5.2.2. Residential Post-application Non-cancer Exposure and Risk Estimates for Thiamethoxam.							
Lifestage	Post-application Exposure Scenario		Amount Applied/ Residue[a]	Dose (mg/kg/day)[b]	MOEs[c]	Combined Routes (X indicates included in Total MOE)	Total MOE (LOC = 100)[d]
	Application Type	Route of Exposure					
	Golfing	Dermal -Liquid		0.00016	7,400		
Child 1 to <2 years	High Contact Lawn	Dermal -Liquid	TTR (µg/cm^2) = 0.0106	0.071	850	X	820
	Lawns/Turf	Hand to Mouth-Liquid	TTR (µg/cm^2) = 0.0106	0.0014	22,000	X	
		Object to Mouth-Liquid		0.000044	720,000		
		Soil ingestion- Liquid	0.266 lb ai/A	9.0E-06	3,500,000		
		Granule ingestion	0.2% ai	0.055	630		
Child 6 to <11 years	Golfing	Dermal -Liquid	TTR (µg/cm^2) = 0.0106	0.00019	6,300		
Child 11 to <16 years	Mowing Turf	Dermal -Liquid	TTR (µg/cm^2) = 0.0106	4.2E-05	29,000		
	Golfing	Dermal -Liquid		0.00016	7,400		
Garden and Trees							
Adult	Gardens	Dermal -Liquid	DFR (ug/cm^2) = 0.486[i]	0.0065	180		
Child 6 to <11 years	Gardens	Dermal -Liquid		0.0038	310		

a. Based on registered labels.
b. Dose (mg/kg/day) algorithms provided in 2012 Residential SOPs (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide).
c. MOE = POD (mg/kg/day) ÷ Dose (mg/kg/day), where acute dietary POD = 34.5 mg/kg/day ; incidental oral POD = 31.6 mg/kg/day, dermal POD (adults) = 1.2 mg/kg/day, dermal POD (children <6 years) = 60 mg/kg/day, inhalation POD (adults) = 1.2 mg/kg/day, and inhalation POD (children <6 years) = 31.6 mg/kg/day.
d. Total MOE = 1 ÷ [(1 ÷ Dermal MOE) + (1 ÷ Inhalation MOE) + (1 ÷ Incidental oral MOE)]
e. Mass of ai applied estimated based on application rate and amount handled for a residential handler (0.0089 lb ai/gal and 0.5 gallons) as described in 2012 Residential SOPs.
f. Based on assumption of 50% of application rate (50% * 0.389 lb ai/A) as described in 2012 Residential SOPs.
g. Based on assumption of 10% of application rate (10% * 0.389 lb ai/A) as described in 2012 Residential SOPs.
h. TTR = adjusted TTR (ug/cm^2) = (TTR from study, 0.0105 ug/cm^2) * (app rate for assessment, 0.266 lb ai/A) / (app rate from study, 0.265 lb ai/A)
i. DFR = adjusted DFR (ug/cm^2) = (DFR from study, 0.243 ug/cm^2) * (app rate for assessment, 0.266 lb ai/A) / (app rate from study, 0.133 lb ai/A)

5.3 Residential Risk Estimates for Use in Aggregate Assessment

Table 5.3.1 reflects the residential risk estimates that are recommended for use in the aggregate assessment for thiamethoxam. The scenarios for residential adult handlers that do not reach the LOC were not considered for inclusion in the aggregate assessment.

- The worst case residential exposure for adults results from post-application dermal exposure to gardens treated with a liquid formulation.
- The worst case residential exposure for children 11 to <16 years old results from post-application dermal exposure golfing on treated turf.
- The worst case residential exposure for children 6 to <11 years old results from post-application dermal exposure to gardens treated with a liquid formulation.
- The worst-case residential exposures for children 1 to <2 years old were associated with post-application exposure to treated carpet following use of thiamethoxam as an indoor spray perimeter/spot/bedbug (coarse or pin stream).

Table 5.3.1. Recommendations for the Residential Exposures for the Thiamethoxam Aggregate Assessment.									
Lifestage	Exposure Scenario	Dose (mg/kg/day)[1]				MOE[2]			
		Dermal	Inhalation	Oral	Total	Dermal	Inhalation	Oral	Total
Adult	Post-application exposure from treated gardens	0.0065	N/A	N/A	0.0065	180	N/A	N/A	180
Child 11 to <16 years	Post-application exposure from golfing on treated turf	0.00016	N/A	N/A	0.00016	7,400	N/A	N/A	7,400
Child 6 to <11 years	Post-application exposure from treated gardens	0.0038	N/A	N/A	0.0038	310	N/A	N/A	310
Child 1 to <2 years	Post-application exposure from treated indoor sprays (perimeter/ spot/ bedbug (coarse and pinstream))	0.086	N/A	0.013	0.0196	700	N/A	2,400	540

1 Dose = the highest dose for each applicable lifestage of all residential scenarios assessed. Total = dermal + inhalation + incidental oral (where applicable).

2 MOE = the MOEs associated with the highest residential doses. Total = 1 ÷ (1/Dermal MOE) + (1/Inhalation MOE) + (1/Incidental Oral MOE), where applicable.

6.0 Non-Occupational Spray Drift Exposure and Risk Estimates

Spray drift is a potential source of exposure to those nearby pesticide applications. This is particularly the case with aerial application, but, to a lesser extent, spray drift can also be a potential source of exposure from the ground application methods (e.g., groundboom and airblast) employed for thiamethoxam. The agency has been working with the Spray Drift Task Force (a task force composed of various registrants which was developed as a result of a Data Call-In issued by EPA), EPA Regional Offices and State Lead Agencies for pesticide regulation and other parties to develop the best spray drift management practices (see the agency's Spray Drift website for more information).[5] The agency has also developed a policy on how to appropriately consider spray drift as a potential source of exposure in risk assessments for pesticides. The potential for spray drift will be quantitatively evaluated for each pesticide during the *Registration Review* process which ensures that all uses for that pesticide will be considered concurrently. The approach is outlined in the revised (2012) *Standard Operating Procedures For Residential Risk Assessment (SOPs) - Residential Exposure Assessment Standard Operating Procedures Addenda 1: Consideration of Spray Drift.* This document outlines the quantification of indirect non-occupational exposure to drift.

Off-target movement of pesticides can occur via many types of pathways and it is governed by a variety of factors. Sprays that are released and do not deposit in the application area end up off-target and can lead to exposures to those it may directly contact. They can also deposit on surfaces where contact with residues can eventually lead to indirect exposures (*e.g.*, children playing on lawns where residues have deposited next to treated fields). The potential risk

[5] Available: [HYPERLINK "http://www.epa.gov/reducing-pesticide-drift"]

estimates from these residues can be calculated using drift modeling coupled with methods employed for residential risk assessments for turf products.

The approach to be used for quantitatively incorporating spray drift into risk assessment is based on a premise of compliant applications which, by definition, should not result in direct exposures to individuals because of existing label language and other regulatory requirements intended to prevent them.[6] Direct exposures would include inhalation of the spray plume or being sprayed directly. Rather, the exposures addressed here are thought to occur indirectly through contact with impacted areas, such as residential lawns, when compliant applications are conducted. Given this premise, exposures for children (1 to 2 years old) and adults who have contact with turf where residues are assumed to have deposited via spray drift thus resulting in an indirect exposure are the focus of this analysis analogous to how exposures to turf products are considered in risk assessment.

Several thiamethoxam products have existing labels for use on turf, thus it was considered whether the risk assessment for that use may be considered protective of any type of exposure that would be associated with spray drift. If the maximum application rate on crops adjusted by the amount of drift expected is less than or equal to existing turf application rates, the existing turf assessment is considered protective of spray drift exposure. The currently registered maximum single application rate of thiamethoxam is 0.266 lb ai/A (sod farms). The highest degree of spray drift noted for any application method immediately adjacent to a treated field (Tier 1 output from the aerial application using fine to medium spray quality) results in a deposition fraction of 0.26 of the application rate. A quantitative spray drift assessment for thiamethoxam is not required because the maximum application rate to a crop/target site multiplied by the adjustment factor for drift of 0.26 is less than the maximum direct spray residential turf application rate of 0.266 lb ai/A[7] for any thiamethoxam products. The turf post-application MOEs have been previously assessed, are based on the revised SOPs for Residential Exposure Assessment (i.e., see above in Section 5.2), and are not of concern.

7.0 Non-Occupational Bystander Post-Application Inhalation Exposure and Risk Estimates

Volatilization of pesticides may be a source of post-application inhalation exposure to individuals nearby pesticide applications. The agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009, and received the SAP's final report on March 2, 2010 (http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2009-0687-0037). The agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis (http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0219).
During Registration Review, the agency will utilize this analysis to determine if data (i.e., flux studies, route-specific inhalation toxicological studies) or further analysis is required for thiamethoxam.

---

[6] This approach is consistent with the requirements of the EPA's Worker Protection Standard which, when included on all labels, precludes direct exposure pathways.
[7] 0.266 lb ai/A x 0.26 ≤ 0.266 lb ai/A

8.0 Occupational Exposure and Risk Estimates

8.1 Occupational Handler Exposure/Risk Estimates

HED uses the term handlers to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct job functions or tasks related to applications and exposures can vary depending on the specifics of each task. Job requirements (amount of chemical used in each application), the kinds of equipment used, the target being treated, and the level of protection used by a handler can cause exposure levels to differ in a manner specific to each application event.

Based on the anticipated use patterns and current labeling, types of equipment and techniques that can potentially be used, occupational handler exposure is expected from existing uses. The quantitative exposure/risk assessment developed for occupational handlers is based on the scenarios listed in Table 8.1.1.

Occupational Handler Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the occupational handler risk assessments. Each assumption and factor is detailed below on an individual basis.

Application Rate: The registered application rates for thiamethoxam are listed in Appendix Tables A.1, A.2, and A.3.

Unit Exposures:

Foliar Uses: It is the policy of HED to use the best available data to assess handler exposure. Sources of generic handler data, used as surrogate data in the absence of chemical-specific data, include PHED 1.1, the AHETF database, the ORETF database, or other registrant-submitted occupational exposure studies. Some of these data are proprietary (e.g., AHETF data), and subject to the data protection provisions of FIFRA. The standard values recommended for use in predicting handler exposure that are used in this assessment, known as "unit exposures", are outlined in the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table[8]", which, along with additional information on HED policy on use of surrogate data, including descriptions of the various sources, can be found at the Agency website[9].

Seed Treatment Uses: For most of the seed treatment scenarios, unit exposures are from ExpoSAC Policy 14: SOPs for Seed Treatment (May 1, 2003), which are based on data for open mixing/loading/application systems. Since the unit exposures for commercial mixers/loaders in Policy 14 are representative of liquid formulations, surrogate unit exposures are used from the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" for mixer/loaders of wettable powders and wettable powders in water

[8] Available: https://www.epa.gov/sites/production/files/2016-11/documents/handler-exposure-table-2016.pdf
[9] Available: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data

soluble bags. Several thiamethoxam seed treatment labels also allow for closed loading systems, and for those scenarios, exposure data from a chemical-specific study which provided the dermal and inhalation exposures for seed treatment handlers using closed loading systems (and wearing additional PPE) were used (MRID 45200002; D273566). The on-farm unit exposure values provided in Policy 14 are representative of dust formulations, however, all thiamethoxam products which allow for on-farm seed treatment are for liquid formulations. Therefore, surrogate data from the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" for mixing/loading liquid formulations were used for that scenario. A summary of the unit exposure data used in the thiamethoxam seed treatment assessment are provided below.

Seed Treatment Unit Exposure Data				
Activity		Dermal UE (ug/lb ai)	Inhalation UE (ug/lb ai)	Source
Commercial Open Loading System				
Mixer/Loader	Liquids	23 (SL/G) 18 (DL/G)	0.34 (No R) 0.068 (PF5) 0.034 (PF10)	Policy 14
	WP/Dust	77.7 (SL/No G) 57.5 (SL/G) 32.8 (DL/G) 12.5 (EC)	2.75 (No R) 0.55 (PF5) 0.275 (PF10) 2.6 (EC)	Occupational Pesticide Handler Unit Exposure Surrogate Reference Table
	WP in WSB	12.5 (EC)	2.6 (EC)	
Sewer		6.2 (SL/No G) 5.8 (SL/G)[a] 2.9 (DL/G)[b]	0.23 (No R) 0.046 (PF5) 0.023 (PF10)	Policy 14
Bagger		9.1 (SL/No G) 6.7 (SL/G)[a] 3.5 (DL/G)[b]	0.16 (No R) 0.032 (PF5) 0.016 (PF10)	
Multiple Activities		42 (SL/G) 26 (DL/G)[b]	1.6 (No R) 0.32 (PF5) 0.163 (PF10)	
Commercial Closed Loading System				
Treater (loader/applicator)		1.1 (DL/G)	0.11 (No R)	MRID 45200002; D273566
Sewer/bagger/stacker (tyvek coveralls)		0.27 (DL/G)	0.064 (No R)	
Sewer/bagger/stacker (cotton coveralls)		0.37 (DL/G)	0.064 (No R)	
Forklift		0.145 (DL/G)	0.01 (No R)	
Total Clean-Out		0.08198 (DL/G; mg/kg/day)	0.0033 (No R; mg/kg/day)	
Partial Clean-Out		0.00669 (DL/G; mg/kg/day)	0.00119 (No R; mg/kg/day)	
On-farm System				
Treater	Liquids	220 (SL/No G) 37.6 (SL/G) 29.1 (DL/G)	0.219 (No R) 0.0438 (PF5) 0.0219 (PF10)	Occupational Pesticide Handler Unit Exposure Surrogate Reference Table
Loader/Planter				
Loader/Planter		250 (SL/G) 196 (DL/G)[b]	3.4 (No R) 0.68 (PF5) 0.34 (P10)	Policy 14

a. Policy 14 does not provide a unit exposure (UE) for a single layer of clothing with gloves for sewers and baggers; however, tables 6 and 9 in the policy provide separate UEs for a single layer of clothing w/o gloves and for hands only (no gloves) for each scenario. The single layer w/gloves UE was estimated by subtracting the hands only UE from the single layer w/o gloves UE (to obtain the

single layer only UE), applying a 90% protection factor to the hands only (no gloves) UE, and then adding that value back to the single layer UE.
b. Policy 14 does not provide a UE for a double layer of clothing with gloves for the multiple activities or loader/planter scenarios; however, tables 12 and 18 of the policy provide separate UEs for a single layer of clothing w/gloves and for hands only (glove) for each scenario. The double layer w/gloves UE was estimated by subtracting the hands only UE from the single layer w/gloves UE, applying a 50% protection factor to the single layer UE, and then adding the hands only (glove) UE to the resulting value.

Area Treated or Amount Handled:

Foliar Uses: The area treated/amount handled are based on ExpoSAC Policy 9.1 and the SOPs for Seed Treatment.

Seed Treatment Uses: HED is currently in the process of revising ExpoSAC Policy 15: Amount of Seed Treated or Planted per Day (March 2, 2004) in efforts to update the daily amount of seed treated in commercial seed treatment facilities. With the increasing demand for hybridized treated seeds, there have been modifications not only in the seed treatment equipment, but in the market shares of new and currently registered pesticide products. HED understands that due to the high cost of producing hybrid seeds, direct seeding is done in a precise manner which requires lower volumes of seed per acre. However, this does not provide a direct correlation to the amount of seed which is treated in the commercial seed treatment facilities.

The amount of seed handled (for both treaters and planters) is based on HED ExpoSAC Policy 15, HED ExpoSAC Policy 15.1, phase 2 of the AHETF seed treatment survey (MRID 49185401) and the BEAD memo: "Acres Planted per Day and Seeding Rates of Crops Grown in the United States." In some cases, the amount of seed planted per day is a conservative calculation based on a low amount of seeds per pound and a high amount of seeds planted per acre (e.g., for sugar beets: 435,600 seeds/acre ÷ 22,000 seeds/lb * 80 acres planted per day = 1,600 lbs seed).

In some cases, the labels included a restriction on the amount of product to be applied per day. HED incorporated this restriction and reduced the pound of seed treated recommended in Policy 15.1 in those cases where applicable.

Exposure Duration: HED classifies exposures from 1 to 30 days as short-term and exposures 30 days to six months as intermediate-term. Exposure duration is determined by many things, including the exposed population, the use site, the pest pressure triggering the use of the pesticide, and the cultural practices surrounding that use site. For most agricultural uses, it is reasonable to believe that occupational handlers will not apply the same chemical every day for more than a one-month time frame; however, there may be a large agribusiness and/or commercial applicators who may apply a product over a period of weeks (e.g., completing multiple applications for multiple clients within a region). For thiamethoxam, based on the existing uses, both short- and intermediate-term exposures are expected for occupational handlers because it could be applied multiple times per season to many registered crops.

Mitigation/Personal Protective Equipment: Estimates of dermal and inhalation exposure were calculated for various levels of PPE. Results are presented for "baseline," defined as a single layer of clothing consisting of a long sleeved shirt, long pants, shoes plus socks, no protective gloves, and no respirator, as well as baseline with various levels of PPE as necessary (e.g.,

gloves, respirator, etc). The registered thiamethoxam labels require baseline attire (long sleeved shirts, long pants, shoes, and socks) and in some cases PPE including chemical resistant gloves and protective eyewear. Several of the seed treatment labels require additional PPE in addition to baseline clothing, such as gloves, coveralls and respirators, and some indicate closed mixing/loading systems are required.

Occupational Handler Non-Cancer Exposure and Risk Estimate Equations
The algorithms used to estimate non-cancer exposure and dose for occupational handlers can be found in Appendix B.

Combining Exposures/Risk Estimates:
Dermal and inhalation risk estimates were combined in this assessment, since the toxicological effects for these exposure routes were similar. Dermal and inhalation risk estimates were combined using the following formula:

[SEQ CHAPTER \h \r 1] *Total MOE = Point of Departure (mg/kg/day) ÷ Combined dermal + inhalation dose (mg/kg/day)*

Summary of Occupational Handler Non-Cancer Exposure and Risk Estimates

Foliar Uses:
The majority of the occupational handler combined (dermal and inhalation) risk estimates did not result in risk estimates of concern (MOEs ≥ 100) with baseline attire. Of the 91 total occupational handler exposure scenarios assessed, 80 scenarios are not of concern (i.e., total MOEs ≥ 100) with baseline attire consisting of long-sleeved shirt, long pants, and shoes plus socks (or engineering controls for aerial applications). Of the remaining 11 handler exposure scenarios, all are not of concern with consideration of increasing levels of dermal and respiratory protection. Eight of those scenarios only require the addition of gloves to reach acceptable MOEs, and all labels reviewed already included a requirement for gloves to be worn; therefore, 3 scenarios require mitigation above what is currently on the registered labels to reach acceptable MOEs.

A summary of the exposure and risk estimates for the foliar uses of thiamethoxam are provided in Appendix C.

The Agency matches quantitative occupational exposure assessment with appropriate characterization of exposure potential. While HED presents quantitative risk estimates for human flaggers where appropriate, agricultural aviation has changed dramatically over the past two decades. According the 2012 National Agricultural Aviation Association (NAAA) survey of their membership, the use of GPS for swath guidance in agricultural aviation has grown steadily from the mid 1990's. Over the same time period, the use of human flaggers for aerial pesticide applications has decreased steadily from ~15% in the late 1990's to only 1% in the most recent (2012) NAAA survey. The Agency will continue to monitor all available information sources to best assess and characterize the exposure potential for human flaggers in agricultural aerial applications.

HED has no data to assess exposures to pilots using open cockpits. The only data available is for exposure to pilots in enclosed cockpits. Therefore, risks to pilots are assessed using the engineering control (enclosed cockpits) and baseline attire (long-sleeve shirt, long pants, shoes, and socks); per the Agency's Worker Protection Standard stipulations for engineering controls, pilots are not required to wear protective gloves for the duration of the application. With this level of protection, there are no risk estimates of concern for applicators.

Seed Treatment:
When using an open loading system for commercial seed treatment, there are only a few scenarios that do not reach acceptable combined (dermal + inhalation) MOEs (i.e., MOEs ≥ 100) assuming a worker is wearing a single layer of clothing, gloves and no respirator (the lowest level of clothing and PPE on some seed treatment labels). Several of these scenarios reach acceptable MOEs (i.e., MOEs ≥ 100) with additional PPE such as coveralls (i.e., a double layer of clothing) and/or a respirator. For some scenarios, MOEs are still not above the LOC of 100 even with a double layer of clothing, gloves, and a PF10 respirator (combined dermal + inhalation MOEs range from 64 to 97). These uses include seed treatment for corn (pop and sweet). It should be noted some labels reviewed for these particular seed treatment uses included requirements for treaters and/or multiple activity workers to wear coveralls (considered a double layer of clothing) and in some cases a respirator.

When using a closed loading system for commercial seed treatment, there are no risk estimates of concern (combined dermal + inhalation) for all seed treatment worker activities (this assumes workers are wearing a double layer of clothing and no respirator as this is representative of clothing worn in the exposure study on which the unit exposures are based).

For on-farm seed treatment, there are no risk estimates of concern (combined dermal + inhalation) for all seed treatment workers assuming they are wearing a single layer of clothing and no respirator.

For seed planters, there are no risk estimates of concern.

A summary of the exposure and risk estimates for the seed treatment uses of thiamethoxam that have risk estimates of concern are provided in Appendix C.

8.2 Occupational Post-Application Exposure/Risk Estimates

HED uses the term post-application to describe exposures that occur when individuals are present in an environment that has been previously treated with a pesticide (also referred to as re-entry exposure). Such exposures may occur when workers enter previously treated areas to perform job functions, including activities related to crop production, such as scouting for pests or harvesting. Post-application exposure levels vary over time and depend on such things as the type of activity, the nature of the crop or target that was treated, the type of pesticide application, and the chemical's degradation properties. In addition, the timing of pesticide applications, relative to harvest activities, can greatly reduce the potential for post-application exposure.

8.2.1 Occupational Post-application Inhalation Exposure/Risk Estimates

There are multiple potential sources of post-application inhalation exposure to individuals performing post-application activities in previously treated fields. These potential sources include volatilization of pesticides and resuspension of dusts and/or particulates that contain pesticides. The agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009, and received the SAP's final report on March 2, 2010 (http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2009-0687-0037). The agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis ([HYPERLINK "https://www.regulations.gov/" \l "!docketDetail;D=EPA-HQ-OPP-2014-0219"]). During Registration Review, the agency will utilize this analysis to determine if data (i.e., flux studies, route-specific inhalation toxicological studies) or further analysis is required for thiamethoxam.

In addition, the Agency is continuing to evaluate the available post-application inhalation exposure data generated by the Agricultural Reentry Task Force. Given these two efforts, the Agency will continue to identify the need for and, subsequently, the way to incorporate occupational post-application inhalation exposure into the agency's risk assessments.

Although a quantitative occupational post-application inhalation exposure assessment was not performed, an inhalation exposure assessment was performed for occupational/commercial handlers. Handler exposure resulting from application of pesticides outdoors is likely to result in higher exposure than post-application exposure. Therefore, it is expected that these handler inhalation exposure estimates would be protective of most occupational post-application inhalation exposure scenarios.

Furthermore, inhalation exposure during dusty mechanical activities such as shaking and mechanical harvesting is another potential source of post-application inhalation exposure. However, the airblast applicator scenario is believed to represent a reasonable worst case surrogate estimate of post-application inhalation exposure during these dusty mechanical harvesting activities. The non-cancer inhalation risk estimate for commercial airblast application is not of concern (i.e., MOE > 100).

The Worker Protection Standard for Agricultural Pesticides contains requirements for protecting workers from inhalation exposures during and after greenhouse applications through the use of ventilation requirements. [40 CFR 170.110, (3) (Restrictions associated with pesticide applications)]

Commercial applicators do not typically return to the treated areas after an indoor commercial pesticide application (sites such as warehouses, food handling establishments, and hotels, etc.) and thus an occupational post-application inhalation exposure assessment was not performed for commercial applicators.

Seed treatment assessments provide quantitative inhalation exposure assessments for seed treaters and secondary handlers (i.e., planters). It is expected that these exposure estimates would be protective of any potential low-level post-application inhalation exposure that could result from these types of applications.

8.2.2 Occupational Post-application Dermal Exposure/Risk Estimates

Occupational Post-application Dermal Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the occupational post-application risk assessments. Each assumption and factor is detailed below on an individual basis.

Exposure Duration: HED classifies exposures from 1 to 30 days as short-term and exposures 30 days to six months as intermediate-term. Exposure duration is determined by many things, including the exposed population, the use site, the pest pressure triggering the use of the pesticide, and the cultural practices surrounding that use site. For most agricultural uses, it is reasonable to believe that occupational post-application workers will not apply the same chemical every day for more than a one-month time frame; however, there may be a large agribusiness and/or commercial applicators who may apply a product over a period of weeks (e.g., completing multiple applications for multiple clients within a region).

Transfer Coefficients: It is the policy of HED to use the best available data to assess post-application exposure. Sources of generic post-application data, used as surrogate data in the absence of chemical-specific data, are derived from ARTF exposure monitoring studies, and, as proprietary data, are subject to the data protection provisions of FIFRA. The standard values recommended for use in predicting post-application exposure that are used in this assessment, known as "transfer coefficients", are presented in the ExpoSAC Policy 3[10]" which, along with additional information about the ARTF data, can be found at the Agency website[11].

Application Rate: The registered application rates for thiamethoxam are listed in Table 4.1.

Exposure Time: The average occupational workday is assumed to be 8 hours.

Dislodgeable Foliar Residue (DFR) Data: As noted in the residential post-application section, a DFR study is available for thiamethoxam (MRID 46039901, D441508), and these data were used in the occupational post-application assessment. A summary of the data is provided in Section 5.2.

Turf Transferable Residue (TTR) Data: As noted in the residential post-application section, a TTR study is available for thiamethoxam (MRID 46402915, D321327), and these data were used

[10] Available: https://www.epa.gov/sites/production/files/2016-12/documents/usepa-opp-hed_exposac_policy_3_january2017.pdf
[11] Available: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-post-application-exposure

in the occupational post-application assessment. A summary of the data is provided in Section 5.2.

Occupational Post-application Non-Cancer Dermal Exposure and Risk Estimate Equations
The algorithms used to estimate non-cancer exposure and dose for occupational post-application workers can be found in Appendix B.

Occupational Post-application Non-Cancer Dermal Risk Estimates
For the occupational post-application assessment of the foliar uses of thiamethoxam, only the highest crop/transfer coefficient combination for each crop category is presented below in Table 8.2.2, and is considered protective of all other registered crops in that category. All of the dermal post-application exposure scenarios resulted in MOEs greater than the LOC (MOE ≥ 100) on the day of application and are not of concern (MOEs range from 100 to 5,300).

Table 8.2.2. Occupational Post-application Non-Cancer Dermal Exposure and Risk Estimates for Thiamethoxam.

Policy Crop Group Category	Crops	Application Rate[1] (lb ai/A)	Maximum Transfer Coefficient[2] (cm^2/hr)	Activities for MaximumTC	DAT (Day After Treatment)	DFR Residue[3] (ug/cm^2)	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]
Berry, low	Cranberry	0.063	1100	Hand harvesting (raking), scouting	0	0.12	0.00073	1,600
Bunch/bundle	Tobacco	0.047	1900	Irrigation (hand set)	0	0.086	0.00095	1,300
Field / row crop, low / medium	Cotton	0.063	5050	Harvesting, Mechanical, Tramper	0	0.13	0.0037	330
Tree, "fruit", deciduous	Apple, Apricot, Cherry, Nectarine, Peach, Pear, Plum, Prune	0.088	3600	Thinning Fruit	0	0.16	0.0034	360
Tree, "fruit", evergreen	Date	0.063	3600	Thinning Fruit	0	0.12	0.0024	500
Tree, "nut"	Olive	0.063	3600	Thinning Fruit	0	0.12	0.0024	500
Turf / sod	Golf Course	0.266	3700	Maintenance	0	0.011	0.00023	5,300
	Sod	0.266	6700	Maintenance; Harvesting, Slab; Transplanting/Planting	0	0.011	0.00041	2,900
Unassigned	Nursery Crop (Ornamentals, Non-bearing Plants)	0.266	1900	Irrigation (hand set)	0	0.49	0.0054	220
	Greenhouse Crop (Ornamentals, Non-bearing Plants)	0.266	230	Harvesting, hand; Pruning, hand; Scouting; Container moving; Weeding, hand; Transplanting; Grafting; Propagating; Pruning, hand; Transplanting;	0	0.49	0.00065	1,900

Table 8.2.2. Occupational Post-application Non-Cancer Dermal Exposure and Risk Estimates for Thiamethoxam.								
Policy Crop Group Category	**Crops**	**Application Rate[1] (lb ai/A)**	**Maximum Transfer Coefficient[2] (cm^2/hr)**	**Activities for MaximumTC**	**DAT (Day After Treatment)**	**DFR Residue[3] (ug/cm^2)**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**
				Pinching, Tying/Training				
Vegetable, "root"	Carrot	0.063	1900	Irrigation (hand set)	0	0.12	0.0013	950
Vegetable, cucurbit	Cantaloupe, Cucumber, Gourd, Pumpkin, Summer Squash, Winter Squash, Watermelon	0.086	1900	Irrigation (hand set)	0	0.16	0.0017	690
Vegetable, fruiting	Eggplant, Bell Pepper, Chili Pepper, Tomato, Tomato Processing	0.086	1900	Irrigation (hand set)	0	0.16	0.0017	690
Vegetable, head and stem Brassica	Broccoli	0.086	4200	Scouting; Harvesting, Hand; Weeding, Hand	0	0.16	0.0038	310
Vegetable, leafy	Cabbage, chinese, Napa	0.086	4200	Weeding, Hand	0	0.16	0.0038	310
Vegetable, stem / stalk	Artichoke	0.047	1900	Irrigation (hand set)	0	0.086	0.00095	1,300
Vine / trellis	Grape, table	0.056	19300	Girdling, Turning	0	0.10	0.011	100

1 Application rates are the maximum application rates determined from EPA registered labels for thiamethoxam.
2 Transfer Coefficient and Post Application Activities from ExpoSAC Policy 3 (revised January 2017).
1 DFR/TTR Data Sources:
DFR: MRID 46039901; Predicted Day 0 residue = 0.243 ug/cm^2; Study application rate = 0.133 lb ai/A
TTR: MRID 46402915: Predicted Day 0 residue = 0.0105 ug/cm^2; Study application rate = 0.265 lb ai/A
4 Daily Dermal Dose = [DFR or TTR ($\mu g/cm^2$) × Transfer Coefficient × 0.001 mg/µg × 8 hrs/day × dermal absorption (5%)] ÷ BW (69 kg).
5 MOE = POD (1.2 mg/kg/day) / Daily Dermal Dose.

Restricted Entry Interval

Thiamethoxam is classified as Toxicity Category III by the acute dermal route of exposure and Toxicity Category IV for acute eye irritation potential and skin irritation potential. Short- and intermediate-term post-application risk estimates were not a concern on day 0 (12 hours following application) for all post-application activities associated with the foliar uses of thiamethoxam. Under 40 CFR 156.208 (c) (2), ai's classified as Acute III or IV for acute dermal, eye irritation and primary skin irritation are assigned a 12-hour REI. Therefore, the [156 subpart K] Worker Protection Statement interim REI of 12 hours is adequate to protect agricultural workers from post-application exposures to thiamethoxam.

With regard to seed treatment, the potential for post-application exposures following the planting of thiamethoxam-treated seeds is unlikely because sustained levels of contact with treated seed after it has been placed in the soil or other planting media would not be expected because no routine cultural practice required for the production of agricultural commodities involves such an activity, as defined in the no/low contact criteria in the WPS.

Appendix A. Summary of Use Directions

Table A.1. Summary of Directions for Agricultural Occupational Uses of Thiamethoxam

Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Formulations	RTI
Artichoke	Liquid, DF	Broadcast	Aerial, Ground	3 fl oz/A	0.047 lb ai/A	100-1250; 100-938	7 days
Barley, Bushberry Group	Liquid, DF	Broadcast	Aerial, Ground	4 fl oz/A	0.063 lb ai/A	100-1250; 100-938	7 days
Brassica (Head and Stem) Vegetables; Cucurbit Vegetables; Leafy Greens; Leafy Vegetables; Fruiting Vegetables	Liquid	Broadcast	Aerial, Ground	5.5 fl oz/A	0.086 lb ai/A	100-1250	7 days for Brassica (Head and Stem), Leafy Greens, and Leafy Vegetables; 5 days for Cucurbit Vegetables and Fruiting Vegetables
	DF	Broadcast	Aerial, Ground	7 oz/A	0.088 lb ai/A	100-1319; 100-938	
Caneberry Subgroup	Liquid, DF	Broadcast	Aerial, Ground	3 fl oz/A	0.047 lb ai/A	100-1250; 100-938	7 days
Citrus	DF	Broadcast	Aerial, Airblast	7 oz/A	0.088 lb ai/A	100-1319; 100-938	7 days
Cotton	Liquid	Broadcast	Aerial, Ground	3.2 fl oz/A	0.05 lb ai/A	100-1250	5 days
	DF	Broadcast	Aerial, Ground	2.5 oz/A	0.063 lb ai/A	100-1147	
Cranberry	Liquid, DF	Broadcast	Ground, Chemigation	4 fl oz/A	0.063 lb ai/A	100-1250; 100-938	7 days
Grapes	Liquid	Broadcast	Aerial, Airblast	3.5 fl oz/A	0.055 lb ai/A	100-1250	14 days
	DF	Broadcast	Aerial, Airblast	4.5 oz/A	0.056 lb ai/A	100-1319	
Low Growing Berries (except cranberry)	DF	Broadcast	Ground	4 oz/A	0.063 lb ai/A	100-938	10 days
Mint / Spearmint / Peppermint	Liquid	Broadcast	Aerial, Ground	4 fl oz/A	0.063 lb ai/A	100-1250; 100-1319; 100-938	14 days
	DF			5 oz/A			
Ornamentals in greenhouses, lath- and shade-houses, containers, field nurseries (including non-bearing fruit and nut trees), Christmas trees	Granule	Broadcast/ Banded	Handheld equipment	120 lb/A	0.264 lb ai/A	100-960*	NS
	DF	Broadcast	Aerial, Ground Handheld, Commercial automatic greenhouse fogger	17 oz/A or 8.5 oz/100 gal	0.266 lb ai/A or 0.0013 lb ai/gallon	100-955	NS

Table A.1. Summary of Directions for Agricultural Occupational Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Formulations	RTI
			(no handheld fogger)				
Pecan	Liquid	Broadcast	Aerial, Airblast	4 fl oz/A	0.063 lb ai/A	100-1250	7 days
Pome Fruits, Stone Fruits	Liquid	Broadcast	Airblast	5.5 fl oz/A	0.086 lb ai/A	100-1250	10 days for pome fruits; 7-10 days for stone fruits
	DF	Broadcast	Aerial, Airblast	7 oz/A	0.088 lb ai/A	100-1319; 100-938	
Root Vegetables (except Sugar Beets)	Liquid	Broadcast	Aerial, Ground	4 fl oz/A	0.063 lb ai/A	100-1250	7 days
	DF			3 oz/A	0.047 lb ai/A	100-938	
Tuberous and corm vegetables (including potato)	Liquid	Broadcast	Aerial, Ground, Chemigation (potato only)	3 fl oz/A	0.047 lb ai/A	100-1250	7 days
	DF	Broadcast	Aerial, Ground, Chemigation (potato only)	4 oz/A	0.05 lb ai/A	100-1319; 100-938	
Sod Farms	Granule	Broadcast	Tractor-drawn spreader; Handheld equipment	80 lb/A	0.264 lb ai/A	100-1341; 100-961	NS
	DF	Broadcast	Aerial, Ground	17 oz/A	0.266 lb ai/A	100-943	NS
Soybeans	DF	Broadcast	Aerial, Ground	2.5 oz/A	0.063 lb ai/A	100-1147	7 days
Sugar beet	DF	Broadcast	Aerial, Ground	4 oz/A	0.063 lb ai/A	WA130009	
Strawberry	Liquid	Broadcast	Ground	4 fl oz/A	0.063 lb ai/A	100-1250	10 days
	DF			5 oz/A		100-1319	
Tropical Fruit	DF	Broadcast	Aerial, Airblast	4 oz/A	0.063 lb ai/A	100-938	7 days
Tobacco	Liquid	Broadcast	Aerial, Ground	3 fl oz/A	0.047 lb ai/A	100-1250	NA
	DF	Broadcast	Aerial, Ground	4 oz/A	0.05 lb ai/A	100-1319; 100-938	3 days
Tree Nuts	DF	Broadcast	Aerial, Airblast	2.5 oz/A	0.063 lb ai/A	100-1147	7 days

Table A.1. Summary of Directions for Agricultural Occupational Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Formulations	RTI
Small Fruit Vine Climbing Subgroup (except Fuzzy Kiwi Fruit and Gooseberry)	DF	Broadcast	Aerial, Airblast	3.5 oz/A	0.055 lb ai/A	100-938	14 days

Table A.2. Summary of Directions for Non-Agricultural Occupational and Residential Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Formulations	Use Directions
Animal housing including broiler houses/poultry houses (walls, ceilings, door frames, warm wall areas near animal pens)	DF	Spot	Spot spray-on using handheld equipment	8 oz/500 sq ft	0.0001 lb ai sq ft	70585-10	
Structural and Perimeter Control (indoor and outdoor): greenhouses, schools, warehouses, apartments, etc (including wood destroying pest control)	Liquid (micro-encapsulated)	Crack and crevice and/or spot treatment.	Backpack, manually-pressurized handwand, mechanically-pressurized handgun,, paintbrush; sprayer	1.1 fl oz/gal and 1 gallon/1000 ft^2	0.0089 lb ai/gal or 1000 ft^2 or 0.3893 lb ai/A	100-1436; 100-1437	For indoor applications, retreat at 21-day intervals or as necessary to maintain control
Indoor Environments – bed bugs	Liquid (micro-encapsulated)		Handheld equipment				
Indoor and Outdoor Residential Areas	Gel		Syringe/ Cartridge / Tube	Not specified	Not specified	100-1261*	Squeeze multiple spots about the size of a pea when needed
Ant Mounds	Liquid (micro-encapsulated)	Spot	Watering can	0.15 fl oz/2.5 gallons	0.062 lb ai/gallon	100-1436; 100-1437	Applications may be made on a monthly basis
	DF	Spot	Handheld sprayer, watering can	3 oz/10 gallons and 3 gallons solution/ mound	0.0047 lb ai/gallon	100-943*	For control of fire ants, make a single drench application when mounds appear to be active

Table A.2. Summary of Directions for Non-Agricultural Occupational and Residential Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Formulations	Use Directions
Turfgrass including golf courses (granule and DF formulations only) residential, institutional, public, commercial or industrial buildings; parks, recreational areas or athletic fields	Granule	Broadcast	Spreader; granule applicator	80 lb/A 0.2% ai	0.264 lb ai/A	100-1341; 100-961	--
	DF	Broadcast	Ground	17 oz/A and 1.5 gallons solution/ 1000 ft^2	0.266 lb ai/A or 0.004 lb ai/gallon	100-943*	--
	Liquid (micro-encapsulated)	Broadcast	Ground	28 fl oz/A and 2 gallons solution/1000 ft^2	0.228 lb ai/A or 0.003 lb ai/gallon	100-1436; 100-1437	Two applications may be made instead at 0.1138 lb ai/A on a 3 to 5 week interval
Ornamentals grown in residential and commercial landscapes, parks, golf courses and interiorscapes	Liquid (micro-encapsulated)	Broadcast	Ground	0.2 fl oz/1 ft tree height or DBH; 13.9 fl oz/100 gallons	0.002 lb ai/ft tree height or DBH; 0.0011 lb ai/gal	100-1436*; 100-1437*	Apply at 7-day intervals if retreatment is necessary
	Liquid	Broadcast	Hose-end sprayer	3 fl oz/gallon and 1 gallon solution/484 ft^2	0.001 lb ai/gallon; 0.07 lb ai/A	100-1367*	
	RTU	Spot	Trigger spray bottle	24 fl oz/bottle and 128 fl oz/484 ft^2	0.00016 lb ai/bottle or 0.075 lb ai/A	100-1366*	Assumed 24 fl oz/bottle
	Granule	Broadcast	Handheld equipment	120 lb/A	0.264 lb ai/A	100-1341; 100-961*	--
	DF	Foliar and Soil Broadcast	Ground	17 oz/A and 1.5 gallons/ 1000 ft^2	0.266 lb ai/A 0.0041 lb ai/gal	100-943*	Repeat applications as necessary to maintain control, but no sooner than every 7 days
		Soil Drench; Soil injection	Soil injector equipment	0.14 oz/1 in DBH or 1 ft plant height	0.0022 lb ai/ft plant height or in DBH	100-943*	--

*This label does not have clothing or PPE requirements

Table A.3. Summary of Directions for Seed Treatment Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Labels	Notes
Alfalfa	Liquid	Commercial seed treatment	Mechanical, slurry-type	0.001 mg ai/seed	0.050 lb ai/100 lb seed	100-941	Label rate based on 210,000 seeds. May be applied by closed or open system seed

Table A.3. Summary of Directions for Seed Treatment Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Labels	Notes
					(assumed 227,000 alfalfa seeds/lb seed)		treatment application processes. Apply in commercial seed treatment facilities only.
Barley	Liquid	Commercial or On-farm	Mechanical, slurry-type	1.33 fl oz/100 lb seed	0.052 lb ai/100 lb seed	100-1527[a]; 100-941	Open or closed systems. Label 100-941 includes restriction of 38 gal product/day.
Beans	Liquid	Commercial or On-farm	Mechanical, slurry-type	3 fl oz/100 lb seed	0.050 lb ai/100 lb seed	100-1247[a]	Open or closed systems
Brassica (Head and Stem) Vegetables	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	0.1 mg ai/seed	4.23 lb ai/100 lb seed (assumed 192,000 Brussels sprouts seeds/lb seed)	100-1294	Open or closed systems
Canola	Liquid	Commercial seed treatment	Mechanical, slurry-type	23 fl oz/100 lb seed	0.40 lb ai/100 lb seed	100-935	For use with closed transfer systems only
Carrot	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	0.05 mg ai/seed	4.41 lb ai/100 lb seed (assumed 400,000 carrot seeds/lb seed)	100-1294	Open or closed systems
Cereal Grains (Buckwheat, Pearl Millet, Proso Millet, Oats, Rye, Teosinte, Triticale, and Wild Rice)	Liquid	Commercial or On-farm	Mechanical, slurry-type	1.33 fl oz/100 lb seed	0.052 lb ai/100 lb seed	100-1527[a]; 100-941	Open or closed systems. Label 100-941 includes restriction of 38 gal product/day.
Corn, Field	Liquid	Commercial seed treatment	Mechanical, slurry-type	1.25 mg ai/seed or 11.61 fl oz/100 lb seed	0.55 lb ai/ 100 lb seed (assumed 2,000 field corn seeds/lb seed)	100-1184[a]; 100-1321[b]; 100-1405[b]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.

Table A.3. Summary of Directions for Seed Treatment Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Labels	Notes
Corn, Pop	Liquid	Commercial seed treatment	Mechanical, slurry-type	1.25 mg ai/seed or 25.8 fl oz/100 lb seed	1.31 lb ai/ 100 lb seed (assumed 4,760 popcorn seeds/lb seed)	100-1184[a]; 100-1321[b]; 100-1405[b]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Corn, Sweet	Liquid	Commercial seed treatment	Mechanical, slurry-type	1.25 mg ai/seed or 20.65 fl oz/100 lb seed	1.24 lb ai/ 100 lb seed (assumed 4,500 seeds/lb seed)	100-1184[a]; 100-1321[b]; 100-1405[b]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Cotton	Liquid	Commercial or On-farm	Mechanical, slurry-type	0.375 mg ai/seed	0.37 lb ai/100 lb seed (assumed 4,500 cotton seeds/lb seed)	100-1321[b]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Oil seed crops (black mustard seed, borage seed, crambe seed, field mustard seed, flax seed, Indian mustard seed, Indian rapeseed seed, rapeseed seed, and safflower seed)	Liquid	Commercial or On-farm	Mechanical, slurry-type	10.24 fl oz/100 lb seed	0.40 lb ai/100 lb seed	100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Cucurbits	Liquid	Commercial or On-farm	Mechanical, slurry-type	0.75 mg ai/seed	3.0 lb ai/100 lb seed (assumed 18,144 cucumber seeds/lb seed)	100-941	Label rate based on an average range of 4,000 to 27,000 cucurbit seeds per pound. May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Leafy Vegetables	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	1.2 mg ai/seed	78.4 lb ai/100 lb seed (assumed 296,500 parsley seeds/lb seed)	100-1294	Open or closed systems

Table A.3. Summary of Directions for Seed Treatment Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Labels	Notes
Legume Vegetables	Liquid	Commercial or On-farm	Mechanical, slurry-type	1.28 fl oz/100 lb seed	0.05 lb ai/100 lb seed	100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Lettuce	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	0.06 mg ai/seed	6.6 lb ai/100 lb seed (assumed 500,000 lettuce seeds/lb seed)	100-1294	Open or closed systems
Onion	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	0.2 mg ai/seed	5.7 lb ai/100 lb seed (assumed 130,000 onion seeds/lb seed)	100-1294	Open or closed systems
Peanuts	Wettable powder	Commercial seed treatment	Mechanical	0.29 mg ai/seed	0.06 lb ai/100 lb seed (assumed 907 peanut seeds/lb seed)	100-1365	Applied as a dry treatment; Open or closed systems
	Dust			4 oz/100 lb seed	0.045 lb ai/ 100 lb seed	100-1438[a]	Open or closed systems
	Liquid		Mechanical, slurry-type	0.29 mg ai/seed	0.06 lb ai/100 lb seed (assumed 907 peanut seeds/lb seed)	100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Peas	Liquid	Commercial or On-farm	Mechanical, slurry-type	1.5 fl oz/100 lb seed	0.025 lb ai/ 100 lb seed	100-1247[a]	Open or closed systems
Potato	Liquid	Commercial seed treatment	Liquid seed treater	0.16 fl oz/100 lb potato	0.0063 lb ai/100 lb potato	100-1248[a]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Rice	Liquid	Commercial or On-farm	Mechanical, slurry-type	0.03 mg ai/seed	0.19 lb ai/100 lb seed	100-941	May be applied by closed or open system seed treatment application processes. Apply

Table A.3. Summary of Directions for Seed Treatment Uses of Thiamethoxam							
Use Site	Formulation	Application Type	Application Equipment	Label Maximum Application Rate	Maximum Application Rate	Registered Labels	Notes
					(assumed 28,100 rice seeds/lb seed)		in commercial seed treatment facilities only. Label 100-941 includes restriction of 38 gal product/day.
Sorghum	Liquid	Commercial or On-farm	Mechanical, slurry-type	7.6 fl oz/100 lb seed	0.30 lb ai/100 lb seed	100-941	Must be applied by closed system seed treatment application processes. Apply in commercial seed treatment facilities only
Soybeans	Liquid	Commercial or On-farm	Mechanical, slurry-type	4.23 fl oz/100 lb seed	0.075 lb ai/100 lb seed	100-1247[a]; 100-1283[a]; 100-1426[a]; 100-1427[a]; 100-1450[a]; 100-1457[b]; 100-1559[a]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only
Spinach	Wettable powder in Water Soluble Bags	Commercial seed treatment	Mechanical, pelleting film coating system	0.12 mg ai/seed	1.2 lb ai/100 lb seed (assumed 45,360 spinach seeds/lb seed)	100-1294	Open or closed systems
Sugar Beet	Liquid	Commercial or On-farm	Mechanical, slurry-type	3.95 fl oz/unit sugar beet seed	0.062 lb ai/100 lb seed	100-941	A unit of sugar beet seed is 100,000 seeds. May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only
Sunflower	Liquid	Commercial or On-farm	Mechanical, slurry-type	0.25 mg ai/seed	0.50 lb ai/100 lb seed (assumed 9,000 sunflower seeds/lb seed)	100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only
Wheat	Liquid	Commercial or On-farm	Mechanical, slurry-type	1.33 fl oz/100 lb seed	0.052 lb ai/100 lb seed	100-1527[a]; 100-941	May be applied by closed or open system seed treatment application processes. Apply in commercial seed treatment facilities only

a. MAI = multiple active ingredient product
b. RUP due to acute inhalation toxicity

Appendix B. Summary of Occupational and Residential Non-cancer Algorithms

1.0 Residential Handlers

1.1 Residential Handler Exposure Calculations

Turf, Gardens and Trees, Indoor Environments

Dermal and Inhalation Handler Exposure Algorithm
Daily dermal and inhalation exposure (mg/day) for residential pesticide handlers, for a given formulation-application method combination, is estimated by multiplying the formulation-application method-specific unit exposure by an estimate of the amount of active ingredient handled in a day, using the equation below:

$E = UE * AR * A$

where:

E = exposure (mg/day);
UE = unit exposure (mg/lb ai);
AR = application rate (e.g., lb ai/ft^2, lb ai/gal); and
A = area treated or amount handled (e.g., ft^2/day, gal/day).

1.2 Residential Handler Dose Calculations

Dermal and/or inhalation absorbed doses normalized to body weight are calculated as:

$D = E * AF / BW$

where:

D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal and/or inhalation); and
BW = body weight (kg).

2.0 Residential Post-application

2.1 Turf/Physical Activities on Turf

Post-application Dermal Exposure Algorithm – Physical Activities on Turf
Exposure resulting from contacting previously treated turf while performing physical activities is calculated as shown below. Residential post-application exposure assessment must include calculation of exposure on the day of application. Therefore, though an assessment can present exposures for any day "t" following the application, it must include "day 0" exposure.

$E = TTRt * CF1 * TC * ET$

where:

E = exposure (mg/day);
TTRt = turf transferable residue on day t ($\mu g/cm^2$);
CF1 = weight unit conversion factor (0.001 mg/µg);
TC = transfer coefficient (cm^2/hr); and
ET = exposure time (hr/day).

If chemical-specific TTR data are available, then surface residues from the day of application should be used (assume that individuals could be exposed to residues immediately after application). However, if data are not available, then TTR_t can be calculated using the following formula:

$TTR_t = AR * F * (1\text{-}FD)_t * CF2 * CF3$

where:

TTRt = turf transferable residue on day t ($\mu g/cm^2$);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
F = fraction of ai as transferable residue following application (unitless);
FD = fraction of residue that dissipates daily (unitless);
t = post-application day on which exposure is being assessed;
CF2 = weight unit conversion factor (4.54×10^8 µg/lb); and
CF3 = area unit conversion factor (1.08×10^{-3} ft^2/cm^2 or 2.47×10^{-8} acre/cm^2).

Dermal absorbed doses are calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal); and
BW = body weight (kg).

Table A-1: Turf (Physical Activities) -- Inputs for Residential Post-application Dermal Exposure

Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
AR	Application rate (mass active ingredient per unit area)		0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
F		L/WP/WDG	0.01

Table A-1: Turf (Physical Activities) -- Inputs for Residential Post-application Dermal Exposure				
Algorithm Notation	Exposure Factor (units)			Point Estimate(s)
	Fraction of AR as TTR following application (if chemical-specific data is unavailable)		Granules	0.002
F_D	Daily residue dissipation (if chemical-specific data is unavailable) (fraction)		L/WP/WDG	0.1
			Granules	0.1
TC	Transfer Coefficient (cm^2/hr)	L/WP/WDG	Adults	180,000
			Children 1 < 2 years old	49,000
		Granules	Adults	200,000
			Children 1 < 2 years old	54,000
ET	Exposure Time (hours per day)		Adults	1.5
			Children 1 < 2 years old	1.5
BW	Body Weight (kg)		Adults	80
			Children 1 < 2 years old	11
L/WP/WDG = Liquids/Wettable Powders/Water-dispersible Granules				

Post-application Hand-to-Mouth Exposure Algorithm– Physical Activities on Turf

Exposure from hand-to-mouth activity is calculated as follows (based on the algorithm utilized in the SHEDS-Multimedia model):

$$E = [HR * (F_M * SA_H) * (ET * N\_Replen) * (1- (1- SE)^{(Freq\_HtM/N-Replen)})]$$

where:

E = exposure (mg/day);
HR = hand residue loading (mg/cm^2);
FM = fraction hand surface area mouthed / event (fraction/event);
SAH = typical surface area of one hand (cm^2);
ET = exposure time (hr/day);
N_Replen = number of replenishment intervals per hour (intervals/hour);
SE = saliva extraction factor (i.e., mouthing removal efficiency); and
Freq_HtM = number of hand-to-mouth contacts events per hour (events/hour).

and

[EMBED Equation.3]

where:

HR = hand residue loading (mg/cm^2);
Fai_{hands} = fraction ai on hands compared to total surface residue from dermal transfer coefficient study (unitless);

DE = dermal exposure (mg); and
SA_H = typical surface area of one hand (cm^2).

Dose, normalized to body weight, is calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table A-2: Turf (Physical Activities) – Inputs for Residential Post-application Hand-to-Mouth Exposure			
Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
Fai_{hands}	Fraction of ai on hands from dermal transfer coefficient study (unitless)	Liquid formulations	0.06
		Granular formulations	0.027
DE	Dermal exposure (mg)		Calculated
SA_H	Typical surface area of one hand (cm^2), children 1 < 2 years old		150
AR	Application rate (mass active ingredient per unit area)		0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
HR	Residue available on the hands (mg/cm^2)		Calculated via (DE * Fai_{hands})/SA_H
F_M	Fraction hand surface area mouthed (fraction/event)		0.127
N_Replen	Replenishment intervals per hour (intervals/hr)		4
ET	Exposure time (hrs/day)		1.5
SE	Saliva extraction factor (unitless)		0.48
Freq_HtM	Hand-to-mouth events per hour (events/hr)		13.9
BW	Body Weight (kg)	Children 1 < 2 years old	11

Post-application Object-to-Mouth Exposure Algorithm– Physical Activities on Turf
Exposure from object-to-mouth activity is calculated as follows (based on the algorithm utilized in SHEDS-Multimedia):

$$E = [OR * CF1 * SAM_O * (ET * N\_Replen) * (1 - (1 - SE_O)^{(Freq\_OtM/N\_Replen)})]$$

where:

E = exposure (mg/day);

OR = chemical residue loading on the object on day "t" (ug/cm^2);
CF1 = weight unit conversion factor (0.001 mg/µg);
SAM_O = area of the object surface that is mouthed (cm^2/event);
ET = exposure time (hr/day);
N_Replen = number of replenishment intervals per hour (intervals/hour);
SE_O = saliva extraction factor (i.e., mouthing removal efficiency); and
Freq_OtM = number of object-to-mouth contact events per hour (events/hour).

and

$$OR = AR * F_O * CF2 * CF3$$

where:

OR = chemical residue loading on the object (µg/cm^2);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
F_O = fraction of residue available on the object (unitless);
CF2 = weight unit conversion factor (4.54 x 10^8 µg/lb); and
CF3 = area unit conversion factor (1.08 x 10^{-3} ft^2/cm^2 or 2.47 x 10^{-8} acre/cm^2).

Dose, normalized to body weight, is calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table A-3: Turf (Physical Activities) – Inputs for Residential Post-application Object-to-Mouth Exposure

Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
AR	Application rate (to turf) (mass active ingredient per unit area)		0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
F_O	Fraction of AR as OR following application [1]		0.01
SAM_O	Surface area of object mouthed (cm^2/event)		10
N_Replen	Replenishment intervals per hour (intervals/hour)		4
SE_O	Saliva extraction factor (fraction)		0.48
ET	Exposure time (hours per day)		1.5
Freq_OtM	Object-to-mouth events per hour (events/hr)		8.8
BW	Body Weight (kg)	Children 1 < 2 years old	11

[1] This SOP assumes that all of the residue on the turf could be transferred to the object (e.g., object residue is equal to turf transferable residue).

Post-application Incidental Soil Ingestion Exposure Algorithm– Physical Activities on Turf
Exposure from incidental soil ingestion is calculated as follows:

$$E = SRt * SIgR * CF1$$

where:
E = exposure (mg/day);
SRt = soil residue on day "t" (µg/g);
SIgR = ingestion rate of soil (mg/day); and
CF1 = weight unit conversion factor (1 x 10^{-6} g/µg).

and

$$SRt = AR * FS * (1-F_D)^t * CF2 * CF3 * CF4$$

where:

SR_t = soil residue on day "t" (µg/g);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
FS = fraction of ai available in uppermost cm of soil (fraction/cm);
F_D = fraction of residue that dissipates daily (unitless);
T = post-application day on which exposure is being assessed;
CF2 = weight unit conversion factor (4.54 x 10^8 µg/lb);
CF3 = area unit conversion factor (1.08 x 10^{-3} ft^2/cm^2 or 2.47 x 10^{-8} acre/cm^2); and
CF4 = soil volume to weight unit conversion factor (0.67 cm^3/g soil).

Dose, normalized to body weight, are calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table A-4: Turf (Physical Activities) – Inputs for Residential Post-application Incidental Soil Ingestion Exposure

Algorithm Notation	Exposure Factor (units)	Point Estimate(s)
AR	Application rate (mass active ingredient per unit area)	0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
FS	Fraction of AR available in uppermost 1 cm of soil (unitless)	1
F_D	Daily residue dissipation (fraction)	0.1
SIgR	Soil ingestion rate (mg/day)	50

Table A-4: Turf (Physical Activities) – Inputs for Residential Post-application Incidental Soil Ingestion Exposure			
BW	Body weight (kg)	Children 1 < 2 years old	11

Post-application Episodic Granular Ingestion Exposure Algorithm– Physical Activities on Turf
Exposure from incidental ingestion of pesticide pellets or granules is calculated as follows:

$$E = GIgR * FD * CF1$$

where:
E = exposure (mg/day);
GIgR = ingestion rate of dry pesticide formulation (g/day);
FD = fraction of ai in dry formulation (unitless); and
CF1 = weight unit conversion factor (1,000 mg/g).

Dose, normalized to body weight, are calculated as:

[EMBED Equation.3]
where:
D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table A-5: Turf (Physical Activities) – Inputs for Residential Post-application Episodic Granular Ingestion Exposure			
Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
F_D	Fraction of active ingredient in dry formulation		0.2%
AR	Application rate (lbs/A or lbs/1,000 ft^2)		0.264 lb ai/A
GIgR	Granule ingestion rate per day (g/day) [1]		0.3
BW	Body Weight (kg)	Children 1 < 2 years old	11
[1] See discussion below on how this value may be adjusted if product specific information is available.			

2.2 Turf/Mowing

Post-application Dermal Exposure Algorithm – Mowing
Exposure resulting from contacting previously treated turf while mowing is calculated as follows:

$$E = TTRt * CF1 * TC * ET$$

where:

E = exposure (mg/day);
TTR_t = turf transferable residue on day "t" (µg/cm^2);
CF1 = weight unit conversion factor (0.001 mg/µg);
TC = transfer coefficient (cm^2/hr); and
ET = exposure time (hr/day).

and

$$TTRt = AR * F_{AR} * (1-F_D)^t * CF2 * CF3$$

where:

TTR_t = turf transferable residue on day "t" (µg/cm^2);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
F_{AR} = fraction of ai retained on turf (unitless);
F_D = fraction of residue that dissipates daily (unitless);
t = post-application day on which exposure is being assessed;
CF2= weight unit conversion factor (4.54 x 10^8 µg/lb); and
CF3 = area unit conversion factor (1.08 x 10^{-3} ft^2/cm^2 or 2.47 x 10^{-8} acre/cm^2).

Absorbed dose, normalized to body weight, are calculated as:

[EMBED Equation.3]
where:
D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal); and
BW = body weight (kg).

Table A-6: Turf (Mowing) – Inputs for Residential Post-application Dermal Exposure

Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
AR	Application rate mass active ingredient per unit area		0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
F_{AR}	Fraction of AR as TTR following application	L/WP/WDG	0.01
		Granules	0.002
F_D	Daily residue dissipation	L/WP/WDG	0.1
		Granules	0.1
TC	Transfer Coefficient (cm^2/hr)	Adult	5,500
		Children 11 < 16 years old	4,500
ET	Exposure time (hours per day)		1

Table A-6: Turf (Mowing) – Inputs for Residential Post-application Dermal Exposure			
Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
BW	Body Weight (kg)	Adults	80
		Children 11 < 16 years old	57
L/WP/WDG = liquid/wettable powder/water dispersible granule			

2.3 Turf/Golfing

Post-application Dermal Exposure Algorithm – Golfing

Exposure resulting from contacting previously treated turf while golfing is calculated as follows:

$$E = TTRt * CF1 * TC * ET$$

where:

E = exposure (mg/day);
TTR_t = turf transferable residue on day "t" (µg/cm^2);
CF1 = weight unit conversion factor (0.001 mg/µg);
TC = transfer coefficient (cm^2/hr); and
ET = exposure time (hr/day).

and

$$TTRt = AR * F * (1-F_D)^t * CF2 * CF3$$

where:

TTR_t = turf transferable residue on day "t" (µg/cm^2);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
F = fraction of ai retained on turf (unitless);'
F_D = fraction of residue that dissipates daily (unitless);
t = post-application day on which exposure is being assessed;
CF2 = weight unit conversion factor (4.54 x 10^8 µg/lb); and
CF3 = area unit conversion factor (1.08 x 10^{-3} ft^2/cm^2 or 2.47 x 10^{-8} acre/cm^2).

Absorbed dose, normalized to body weight, is calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal); and
BW = body weight (kg).

Table A-7: Turf (Golfing) – Inputs for Residential Post-application Dermal Exposure			
Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
AR	Application rate (mass active ingredient per unit area)		0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
F	Fraction of AR as TTR following application	L/WP/WDG	0.01
		Granules	0.002
F_D	Daily residue dissipation	L/WP/WDG	0.1
		Granules	0.1
TC	Transfer Coefficient (cm^2/hr)	Adult	5,300
		Children 11 < 16 years old	4,400
		Children 6 < 11 years old	2,900
ET	Exposure time (hours per day)	Pesticides used on greens, tees, and fairways	4
		Pesticides used only on greens and tees	1
BW	Body Weight (kg)	Adults	80
		Children 11 < 16 years old	57
		Children 6 < 11 years old	32
NA = not applicable L/WP/WDG = liquid/wettable powder/water dispersible granule			

2.4 Gardens and Trees

Post-application Dermal Exposure Algorithm

Exposure resulting from contacting previously treated gardens and trees while performing physical activities is calculated as shown below. Residential post-application exposure assessment must include calculation of exposure on the day of application. Therefore, though an assessment can present exposures for any day "t" following the application, it must include "day 0" exposure.

$$E = DFR_t * CF1 * TC * ET$$

where:

E = exposure (mg/day);
DFR_t = dislodgeable foliar residue on day "t" ($\mu g/cm^2$);
CF1 = weight unit conversion factor (0.001 mg/µg);
TC = transfer coefficient (cm^2/hr); and
ET = exposure time (hrs/day).

In the absence of chemical-specific data, DFR_t can be calculated as follows:

$$DFR_t = AR * F_{AR} * (1-F_D)^t * CF2 * CF3$$

where:

DFR_t = dislodgeable foliar residue on day "t" (µg/cm^2);
AR = application rate (lbs ai/ft^2 or lb ai/acre);
F_{AR} = fraction of ai as dislodgeable residue following application (unitless);
F_D = fraction of residue that dissipates daily (unitless);
t = post-application day on which exposure is being assessed;
CF2 = weight unit conversion factor (4.54 x 10^8 µg/lb); and
CF3 = area unit conversion factor (1.08 x 10^{-3} ft^2/cm^2 or 2.47 x 10^{-8} acre/cm^2).

Absorbed dermal dose, normalized to body weight, is calculated as:

[EMBED Equation.3]

where:
D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal and/or inhalation); and
BW = body weight (kg).

Table A-8: Gardens, Trees, and "Pick-your-own" Farms – Inputs for Residential Post-application Dermal Exposure

Algorithm Notation	Exposure Factor (units)				Point Estimate(s)
AR	Application rate (mass ai per unit area)				0.266 lb ai/A for liquids; 0.264 lb ai/A for solids
F_{AR}	DFR following application, if chemical-specific is unavailable (fraction)				0.25
F_D	Daily residue dissipation, if chemical-specific is unavailable (fraction)				0.10
TC	Transfer Coefficient (cm^2/hr)	Gardens[a]	Adults		8400
			Children 6 < 11 years old		4600
		Trees, Retail Plants (if applicable)[a]	Adults		1700
			Children 6 < 11 years old		930
		Indoor Plants	Adults		220
			Children 6 < 11 years old		120
ET	Exposure Time (hours per day)	Home activities[b]	Gardens	Adults	2.2
				Children 6 < 11 years old	1.1
			Trees, Retail Plants (if applicable)	Adults	1.0
				Children 6 < 11 years old	0.50
			Indoor Plants	Adults	1.0
				Children 6 < 11 years old	0.50
			Adults		5.0

Table A-8: Gardens, Trees, and "Pick-your-own" Farms – Inputs for Residential Post-application Dermal Exposure				
Algorithm Notation	Exposure Factor (units)			Point Estimate(s)
		"Pick-your-own" Farms (if applicable)	Children 6 < 11 years old	1.9
BW	Body weight (kg)		Adults	80
			Children 6 < 11 years old	32
[a] Transfer coefficient point estimates from a composite distribution assuming equal proportion of time spent conducting various activities. See "Transfer Coefficient" section below. Children 6 < 11 years old TC derived using surface area adjustment (see *Section 2.3*). [b] Activity time point estimates from a composite distribution assuming equal proportion of each respective activity. Time for children 6 < 11 years old derived using hrs/day ratio adjustment. See "Exposure Time" section below.				

2.5 Indoor Environments

Post-Application Dermal Exposure Algorithm (hard surfaces and carpets)
The algorithm to calculate exposure is as follows:

$$E = TR * TC * ET * CF1$$

where:
E = exposure (mg/day);
TR = indoor surface transferable residue (µg/cm^2);
TC = transfer coefficient (cm^2/hr);
ET = exposure time (hr/day); and
CF1 = conversion factor (0.001 mg/µg).

If chemical-specific TR data are available, this is preferred and should be used to calculate exposure. However, if chemical-specific TR data are not available, then TR can be calculated using the following formula:

$$TR = DepR * F_{ai}$$

where:
TR = indoor surface transferable residue (µg/cm^2);
DepR = deposited residue (µg/cm^2), based on (in order of preference):
(1) Chemical-specific residue deposition data (µg/cm^2),
(2) Application rate (lb ai/area), or
(3) Default residue based on type of application (µg/cm^2); and
F_{ai} = fraction of ai available for transfer from carpet or hard surface (unitless).

Absorbed dermal dose, normalized to body weight, are calculated as:

$$D = \frac{E * AF}{BW}$$

where:
D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor; and
BW = body weight (kg).

Table A-9: Indoor Environments (Hard Surfaces and Carpets) – Inputs for Residential Post-application Dermal Exposure

Algorithm Notation	Exposure Factor (units)			Point Estimate(s)
TR	Transferable residue ($\mu g/cm^2$)			0.13 $\mu g/cm^2$ (perimeter/spot - carpet) 0.18 $\mu g/cm^2$ (perimeter/spot – hard surface) 0.03 $\mu g/cm^2$ (crack/crevice - carpet) 0.04 $\mu g/cm^2$ (crack/crevice – hard surface)
DepR	Deposited residue ($\mu g/cm^2$)			2.19 $\mu g/cm^2$ (perimeter/spot) 0.44 $\mu g/cm^2$ (crack and crevice)
F_{ai}	Fraction of DepR as TR following application	Carpets		0.06
		Hard surfaces		0.08
TC	Transfer Coefficient (cm^2/hr)	Adult		6,800
		Children 1 < 2 years old		1,800
ET	Exposure Time (hrs/day)	Adults	Carpets	8
			Hard Surfaces	2
		Children 1 < 2 years old	Carpets	4
			Hard Surfaces	2
BW	Body weight (kg)	Adult		69
		Children 1 < 2 years old		11

Post-application Object-to-Mouth Exposure Algorithm

Exposure from object-to-mouth activity is calculated as follows (based on algorithm utilized in SHEDS-Multimedia):

$$E = OR * CF1 * SAM_O * (ET * N\_Replen) * \left(1 - (1 - SE)^{\frac{Freq\_OtM}{N\_Replen}}\right)$$

where:

E = exposure (mg/day);
OR = chemical residue loading on an object ($\mu g/cm^2$);
CF1 = weight unit conversion factor (0.001 mg/µg);
SAM_O = area of the object surface that is mouthed (cm^2/event);

ET = exposure time (hr/day);
N_Replen = number of replenishment intervals per hour (intervals/hour);
SE = saliva extraction factor (i.e., mouthing removal efficiency); and
Freq_OtM = number of object-to-mouth contact events per hour (events/hour).

and

$$OR = DepR * F_O$$

where:

OR = chemical residue loading on the object (µg/cm^2);
DepR = deposited residue (µg/cm^2); and
F_O = fraction of residue transferred to an object (unitless).

and

Oral dose, normalized to body weight, is calculated as:

$$D = \frac{E}{BW}$$

where:

D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table A-10: Indoor Environments – Inputs for Residential Post-application Object-to-Mouth Exposure				
Algorithm Notation	Exposure Factor (units)			Point Estimate(s)
AR	Application rate (mass active ingredient per unit area)			**0.389 lb ai/A**
F_O	Fraction of residue transferred to an object	Carpets		0.06
		Hard surfaces		0.08
SAM_O	Surface area of object mouthed (cm^2/event)			10
N_Replen	Replenishment intervals per hour (intervals/hour)			4
SE_O	Saliva extraction factor			0.48
ET	Exposure Time (hours per day)	Children 1 < 2 years old	Carpets	4

Table A-10: Indoor Environments – Inputs for Residential Post-application Object-to-Mouth Exposure				
Algorithm Notation	Exposure Factor (units)			Point Estimate(s)
			Hard Surfaces	2
Freq_OtM	Object-to-mouth events per hour (events/hour)	Children 1 < 2 years old		14
BW	Body Weight (kg)	Children 1 < 2 years old		11

3.0 Occupational Non-cancer Handler Algorithms

Potential daily exposures for occupational handlers are calculated using the following formulas:

$$E = UE * AR * A * 0.001\ mg/ug$$

where:

E = exposure (mg ai/day),
UE = unit exposure (µg ai/lb ai),
AR = maximum application rate according to proposed label (lb ai A or lb ai/gal), and
A = area treated or amount handled (e.g., A/day, gal/day).

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

where:

ADD = average daily dose absorbed in a given scenario (mg ai/kg/day),
E = exposure (mg ai/day),
AF = absorption factor (dermal and/or inhalation), and
BW = body weight (kg).

Margin of Exposure: Non-cancer risk estimates for each application handler scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the toxicological endpoint to the daily dose of concern. The daily dermal and inhalation dose received by occupational handlers are compared to the appropriate POD (i.e., NOAEL) to assess the risk to occupational handlers for each exposure route. All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

where:

MOE = margin of exposure: value used by HED to represent risk estimates (unitless),
POD = point of departure (mg/kg/day), and
ADD = average daily dose absorbed in a given scenario (mg ai/kg/day).

4.0 Occupational Non-cancer Post-application Algorithms

Potential daily exposures for occupational post-application workers are calculated using the following formulas:

$$DFR_t = AR * F * (1-D)^t * \left(4.54E8 \frac{ug}{lb}\right) * \left(2.47E\text{-}8 \frac{A}{cm^2}\right)$$

where:

DFR_t = dislodgeable foliage residue on day "t" (µg/cm^2),
AR = application rate (lb ai/acre),
F = fraction of ai retained on foliage or 25% (unitless),
D = fraction of residue that dissipates daily or 10% (unitless), and
t = number of days after application day (days).

$$E = TC * DFR_t * ET * 0.001 \frac{mg}{ug}$$

where:
E = exposure (mg ai/day),
TC = transfer coefficient (cm^2/hr),
DFR_t = dislodgeable foliar residue on day "t" (µg/cm^2), and
ET = exposure time (hours/day).

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

where:

ADD = average daily dose absorbed in a given scenario (mg ai/kg/day),
E = exposure (mg ai/day),
AF = absorption factor (dermal and/or inhalation), and
BW = body weight (kg).

Margin of Exposure: Non-cancer risk estimates for each scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the toxicological endpoint to the daily dose of concern. The daily dermal dose received by occupational post-application workers is compared to the appropriate POD (i.e., NOAEL) to assess the risk to occupational post-application workers. All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

where:

MOE = margin of exposure: value used by HED to represent risk estimates (unitless),
POD = point of departure (mg/kg/day), and
ADD = average daily dose absorbed in a given scenario (mg ai/kg/day)

Appendix C. Summary Tables for Occupational Handler Exposure and Risk Estimates

Table C.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Agricultural Uses of Thiamethoxam.

Exposure Scenario	Crop / Target Category	Maximum Application Rate[1]	Amount Handled / Area Treated[2]	Unit Exposures [3] (ug/lb ai) Baseline or (PPE)		Dermal		Inhalation		Total MOE (LOC = 100)[6]
				Dermal	Inhalation	Dose [4] (mg/kg-day)	MOE (LOC = 100)[5]	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]	
Mixer/Loader										
Mixing/Loading DF formulations for Aerial Application	Orchard/Vineyard	0.088 lb ai/acre	350 acres	227	8.96	0.0051	240	0.004	300	130
	Sod	0.266 lb ai/acre	350 acres	227	8.96	0.015	**78**	0.012	**99**	**44**
				51.6 (SL/G)	1.792 (PF5)	0.0035 (SL/G)	340 (SL/G)	0.0024 (PF5)	500 (PF5)	200 (SL/G + PF5)
	Field crop, typical	0.088 lb ai/acre	350 acres	227	8.96	0.0051	240	0.004	300	130
	Field crop, high-acreage	0.063 lb ai/acre	1200 acres	227	8.96	0.013	**96**	0.0098	120	**53**
				51.6 (SL/G)	1.792 (PF5)	0.0028 (SL/G)	420 (SL/G)	0.0020 (PF5)	610 (PF5)	250 (SL/G + PF5)
Mixing/Loading DF formulations for Airblast Application	Orchard/Vineyard	0.088 lb ai/acre	40 acres	227	8.96	0.000579	2100	0.000457	2600	1200
Mixing/Loading DF formulations for Chemigation Application	Field crop, typical	0.063 lb ai/acre	350 acres	227	8.96	0.00363	330	0.00287	420	180
	Field crop, high-acreage (potato only)	0.05 lb ai/acre	350 acres	227	8.96	0.00288	420	0.00228	530	230
Mixing/Loading DF formulations for Groundboom Application	Sod	0.266 lb ai/acre	80 acres	227	8.96	0.0035	340	0.00277	430	190
	Field crop, typical	0.088 lb ai/acre	80 acres	227	8.96	0.00116	1000	0.000914	1300	570
	Field crop, high-acreage	0.063 lb ai/acre	200 acres	227	8.96	0.00207	580	0.00164	730	320

Table C.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Agricultural Uses of Thiamethoxam.										
Exposure Scenario	**Crop / Target Category**	**Maximum Application Rate[1]**	**Amount Handled / Area Treated[2]**	**Unit Exposures [3] (ug/lb ai) Baseline or (PPE)**		**Dermal**		**Inhalation**		**Total MOE (LOC = 100)[6]**
				Dermal	**Inhalation**	**Dose [4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	
Mixing/Loading DF formulations for application with stationary fogger (with re-entry restriction)	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00133 lb ai/gallon	1000 gallons	227	8.96	0.000219	5500	0.000172	7000	3100
Mixing/Loading Granules for Tractor-Drawn Spreader Applications	Sod	0.264 lb ai/acre	80 acres	8.4	1.7	0.000128	9400	0.00052	2300	1800
Mixing/Loading Liquids for Aerial Application	Orchard/Vineyard	0.063 lb ai/acre	350 acres	220	0.219	0.00351	340	0.00007	17000	330
	Field crop, typical	0.086 lb ai/acre	350 acres	220	0.219	0.0048	250	0.0000955	13000	250
	Field crop, high-acreage	0.063 lb ai/acre	1200 acres	220	0.219	0.012	100	0.000241	5000	**98**
				37.6 (SL/G)		0.0021 (SL/G)	580 (SL/G)			520 (SL/G +No R)
Mixing/Loading Liquids for Airblast Application	Orchard/Vineyard	0.086 lb ai/acre	40 acres	220	0.219	0.000549	2200	0.0000109	110000	2200
Mixing/Loading Liquids for Chemigation Application	Field crop, typical	0.063 lb ai/acre	350 acres	220	0.219	0.00351	340	0.00007	17000	330
	Field crop, high-acreage (potato only)	0.047 lb ai/acre	350 acres	220	0.219	0.00262	460	0.0000522	23000	450
Mixing/Loading Liquids for Groundboom Application	Field crop, typical	0.086 lb ai/acre	80 acres	220	0.219	0.00109	1100	0.0000219	55000	1100
	Field crop, high-acreage	0.063 lb ai/acre	200 acres	220	0.219	0.00201	600	0.00004	30000	590
Applicator										

Table C.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Agricultural Uses of Thiamethoxam.										
Exposure Scenario	**Crop / Target Category**	**Maximum Application Rate[1]**	**Amount Handled / Area Treated[2]**	**Unit Exposures [3] (ug/lb ai) Baseline or (PPE)**		**Dermal**		**Inhalation**		**Total MOE (LOC = 100)[6]**
				Dermal	**Inhalation**	**Dose [4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	
Applying Sprays with Aerial Application Equipment	Orchard/Vineyard	0.088 lb ai/acre	350 acres	2.08 (EC)	0.0049 (EC)	0.0000464	26000	0.00000219	550000	25000
	Sod	0.266 lb ai/acre	350 acres	2.08 (EC)	0.0049 (EC)	0.000141	8500	0.00000661	180000	8100
	Field crop, typical	0.088 lb ai/acre	350 acres	2.08 (EC)	0.0049 (EC)	0.0000464	26000	0.00000219	550000	25000
	Field crop, high-acreage	0.063 lb ai/acre	1200 acres	2.08 (EC)	0.0049 (EC)	0.000114	11000	0.00000536	220000	10000
Applying Sprays with Airblast Application Equipment	Orchard/Vineyard	0.088 lb ai/acre	40 acres	1770	4.71	0.00451	270	0.000241	5000	260
Applying Sprays with Groundboom Application Equipment	Sod	0.266 lb ai/acre	80 acres	78.6	0.34	0.00121	990	0.000105	11000	910
	Field crop, typical	0.088 lb ai/acre	80 acres	78.6	0.34	0.000401	3000	0.0000346	35000	2800
	Field crop, high-acreage	0.063 lb ai/acre	200 acres	78.6	0.34	0.000717	1700	0.000062	19000	1600
Applying Granules with a Tractor-Drawn Spreader	Sod	0.264 lb ai/acre	80 acres	9.9	1.2	0.000151	7900	0.000367	3300	2300
Flagger										
Flagging for Aerial Applications (Sprays)	Orchard/Vineyard	0.088 lb ai/acre	350 acres	11	0.35	0.000246	4900	0.000157	7600	3000
	Sod	0.266 lb ai/acre	350 acres	11	0.35	0.000739	1600	0.000472	2500	980
	Field crop, typical	0.088 lb ai/acre	350 acres	11	0.35	0.000246	4900	0.000157	7600	3000
	Field crop, high-acreage	0.063 lb ai/acre	350 acres	11	0.35	0.000176	6800	0.000112	11000	4200
Mixer/Loader/Applicator										

Table C.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Agricultural Uses of Thiamethoxam.										
Exposure Scenario	**Crop / Target Category**	**Maximum Application Rate[1]**	**Amount Handled / Area Treated[2]**	**Unit Exposures [3] (ug/lb ai) Baseline or (PPE)**		**Dermal**		**Inhalation**		**Total MOE (LOC = 100)[6]**
				Dermal	**Inhalation**	**Dose [4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	
Mixing/Loading/ Applying DF formulations with a Backpack	Poultry/livestock house/horse barn/feed lot	0.0001 lb ai/ft^2	20,000 ft^2	2510	30	0.00357	340	0.000852	1,400	270
Mixing/Loading/ Applying DF formulations with a Manually-pressurized Handwand	Poultry/livestock house/horse barn/feed lot	0.0001 lb ai/ft^2	20,000 ft^2	100,000	30	0.142	**8.5**	0.000852	1,400	**8.4**
				430 (SL/G)		0.0006 (SL/G)	2,000 (SL/G)			820 (SL/G +No R)
Mixing/Loading/ Applying DF formulations with a Mechanically-pressurized Handgun	Poultry/livestock house/horse barn/feed lot	0.0001 lb ai/ft^2	20,000 ft^2	1800	79	0.00256	470	0.00225	530	250
Loader/Applicator										
Loading/Applying Granule Formulations with a Backpack	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.264 lb ai/acre	1 acres	155	23.8	0.0000296	41000	0.000091	13000	9900
	Christmas Tree farm	0.264 lb ai/acre	1 acres	155	23.8	0.0000296	41000	0.000091	13000	9900
	Nursery (ornamentals, vegetables, trees, container stock)	0.264 lb ai/acre	1 acres	155	23.8	0.0000296	41000	0.000091	13000	9900
Loading/Applying Granule Formulations with a Belly grinder	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560
	Christmas Tree farm	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560
	Nursery (ornamentals, vegetables, trees, container stock)	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560

Table C.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Agricultural Uses of Thiamethoxam.

Exposure Scenario	Crop / Target Category	Maximum Application Rate[1]	Amount Handled / Area Treated[2]	Unit Exposures [3] (ug/lb ai) Baseline or (PPE)		Dermal		Inhalation		Total MOE (LOC = 100)[6]
				Dermal	Inhalation	Dose [4] (mg/kg-day)	MOE (LOC = 100)[5]	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]	
Loading/Applying Granule Formulations with a Rotary spreader	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.264 lb ai/acre	5 acres	440	10	0.000421	2900	0.000191	6300	2000

1 Assessment based on maximum registered application rate for each scenario. Crops were grouped according to application rates and applicable exposure scenarios to cover all uses.
2 Based on ExpoSAC Policy 9.1.
3 Based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data). Level of mitigation: Baseline unless shown otherwise. DL= double layer, EC = engineering control. PF5 = respirator that gives 80% protection, PF10 = respirator that gives 90% protection.
4 Dose = Unit Exposure (μg/lb ai) × Conversion Factor (0.001 mg/μg) × Application Rate (lb ai/ gal or lb ai/A) × Area Treated or Amount Handled Daily (gal/day or A/day) ÷ BW (69 kg). Dermal dose includes a dermal absorption factor of 5%.
5 MOE = POD (1.2 mg/kg/day) ÷ Dose (mg/kg/day). Bold MOEs represent estimates of concern (LOC = 100).
6 Total MOE = NOAEL (1.2 mg/kg/day) ÷ (Dermal Dose mg/kg/day + Inhalation Dose mg/kg/day). Bold MOEs represent estimates of concern (LOC = 100).

Table C.2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Non-Agricultural Uses of Thiamethoxam.

Exposure Scenario	Crop / Target Category	Maximum Application Rate[1]	Amount Handled / Area Treated[2]	Unit Exposures [3] (ug/lb ai) Baseline		Dermal		Inhalation		Total MOE (LOC = 100)[6]
				Dermal	Inhalation	Dose [4] (mg/kg-day)	MOE (LOC = 100)[5]	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]	
Mixer/Loader										
Mixing/Loading DF formulations for Groundboom Application	Golf course (tees and greens only)	0.266 lb ai/acre	5 acres	227	8.96	0.000219	5500	0.000172	7000	3100
	Golf course (fairways, tees, greens)	0.266 lb ai/acre	40 acres	227	8.96	0.00175	690	0.00138	870	380
	Field-grown ornamental crops	0.266 lb ai/acre	40 acres	227	8.96	0.00175	690	0.00138	870	380
Mixing/Loading Granules for Tractor-	Field-grown ornamental crops	0.264 lb ai/acre	40 acres	8.4	1.7	0.0000643	19000	0.000261	4600	3700

Table C.2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Non-Agricultural Uses of Thiamethoxam.										
Exposure Scenario	Crop / Target Category	Maximum Application Rate[1]	Amount Handled / Area Treated[2]	Unit Exposures [3] (ug/lb ai) Baseline		Dermal		Inhalation		Total MOE (LOC = 100)[6]
				Dermal	Inhalation	Dose [4] (mg/kg-day)	MOE (LOC = 100)[5]	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]	
Drawn Spreader Applications	Golf course (fairways, tees, greens)	0.264 lb ai/acre	40 acres	8.4	1.7	0.0000643	19000	0.000261	4600	3700
	Golf course (tees and greens only)	0.264 lb ai/acre	5 acres	8.4	1.7	0.00000804	150000	0.0000325	37000	30000
Applicator										
Applying Sprays with Groundboom Application Equipment	Golf course (tees and greens only)	0.266 lb ai/acre	5 acres	78.6	0.34	0.0000761	16000	0.00000655	180000	15000
	Golf course (fairways, tees, greens)	0.266 lb ai/acre	40 acres	78.6	0.34	0.000606	2000	0.0000525	23000	1800
Applying Granules with a Tractor-Drawn Spreader	Field-grown ornamental crops	0.264 lb ai/acre	40 acres	9.9	1.2	0.0000761	16000	0.000184	6500	4600
	Golf course (fairways, tees, greens)	0.264 lb ai/acre	40 acres	9.9	1.2	0.0000761	16000	0.000184	6500	4600
	Golf course (tees and greens only)	0.264 lb ai/acre	5 acres	9.9	1.2	0.00000949	130000	0.0000229	52000	37000
Applying RTU (L) with Trigger-spray Bottle	Interior landscaping	0.00016 lb ai/bottle	10 bottles	3660	61.2	0.00000425	280000	0.00000142	850000	210000
	Landscaping, plants/flowers	0.00016 lb ai/bottle	10 bottles	3660	61.2	0.00000425	280000	0.00000142	850000	210000
Mixer/Loader/Applicator										
Mixing/Loading/ Applying DF formulations with a Backpack	Landscaping, trees/shrubs/bushes	0.0041 lb ai/gallon	40 gallons	58400	69.1	0.00694	170	0.000164	7300	170
	Landscaping, plants/flowers	0.0041 lb ai/gallon	40 gallons	58400	69.1	0.00694	170	0.000164	7300	170
	Landscaping, turf (lawns, athletic fields, parks, etc.) - Broadcast	0.004 lb ai/gallon	40 gallons	58400	69.1	0.00677	180	0.000161	7500	180

Table C.2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Non-Agricultural Uses of Thiamethoxam.										
Exposure Scenario	**Crop / Target Category**	**Maximum Application Rate[1]**	**Amount Handled / Area Treated[2]**	**Unit Exposures [3] (ug/lb ai) Baseline**		**Dermal**		**Inhalation**		**Total MOE (LOC = 100)[6]**
				Dermal	**Inhalation**	**Dose [4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	
	Landscaping, turf (lawns, athletic fields, parks, etc.) - Spot	0.004 lb ai/gallon	40 gallons	8260	2.58	0.000957	1300	0.00000599	200000	1300
Mixing/Loading/ Applying DF formulations with a Manually-pressurized Handwand	Landscaping, trees/shrubs/bushes	0.0041 lb ai/gallon	40 gallons	100000	30	0.0119	100	0.0000713	17000	99
	Landscaping, plants/flowers	0.0041 lb ai/gallon	40 gallons	100000	30	0.0119	100	0.0000713	17000	99
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.004 lb ai/gallon	40 gallons	100000	30	0.0116	100	0.0000696	17000	99
Mixing/Loading/ Applying DF formulations with a Manually-pressurized Handwand	Mounds/nests	0.0047 lb ai/gallon	40 gallons	100000	30	0.0136	**88**	0.0000817	15000	**87**
				430 (SL/G)		0.000059 (SL/G)	20,000 (SL/G)			8,600 (SL/G + No R)
Mixing/Loading/ Applying Liquids with a Manually-pressurized Handwand	Childcare center/schools/institutions -C&C	0.0089 lb ai/gallon	40 gallons	29000	1100	0.00746	160	0.00568	210	**91**
				8600 (SL/G)		0.0022 (SL/G)	540			150 (SL/G + No R)
Mixing/Loading/ Applying DF formulations with a Manually-pressurized Handwand	Interior landscaping	0.0041 lb ai/gallon	40 gallons	100000	30	0.0119	100	0.0000713	17000	99
Mixing/Loading/ Applying DF formulations with a Mechanically-pressurized Handgun	Golf course (tees and greens only)	0.266 lb ai/acre	5 acres	1960	42	0.00189	630	0.00081	1500	440
	Golf course (fairways, tees, greens)	0.266 lb ai/acre	5 acres	1960	42	0.00189	630	0.00081	1500	440
	Landscaping, trees/shrubs/bushes	0.0041 lb ai/gallon	1000 gallons	6050	8.68	0.018	**67**	0.000516	2300	**65**
				2050 (SL/G)		0.0061 (SL/G)	200 (SL/G			180 (SL/G + No R)

Table C.2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Non-Agricultural Uses of Thiamethoxam.

Exposure Scenario	Crop / Target Category	Maximum Application Rate[1]	Amount Handled / Area Treated[2]	Unit Exposures [3] (ug/lb ai) Baseline		Dermal		Inhalation		Total MOE (LOC = 100)[6]
				Dermal	Inhalation	Dose [4] (mg/kg-day)	MOE (LOC = 100)[5]	Dose[4] (mg/kg-day)	MOE (LOC = 100)[5]	
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.266 lb ai/acre	5 acres	1960	42	0.00189	630	0.00081	1500	440
Mixing/Loading/ Applying Liquids with a Backpack	Landscaping, trees/shrubs/bushes	0.0011 lb ai/gallon	40 gallons	58400	69.1	0.00186	650	0.0000441	27,000	630
	Landscaping, plants/flowers	0.0011 lb ai/gallon	40 gallons	58400	69.1	0.00186	650	0.0000441	27,000	630
	Landscaping, turf (lawns, athletic fields, parks, etc.) – Broadcast	0.003 lb ai/gallon	40 gallons	58400	69.1	0.00508	240	0.00012	10000	230
	Landscaping, turf (lawns, athletic fields, parks, etc.) - Spot	0.003 lb ai/gallon	40 gallons	8260	2.58	0.000718	1700	0.00000449	270000	1700
Mixing/Loading/ Applying Liquids with a Manually-pressurized Handwand	Landscaping, trees/shrubs/bushes	0.0011 lb ai/gallon	40 gallons	100000	30	0.00319	380	0.0000191	63,000	380
	Landscaping, plants/flowers	0.0011 lb ai/gallon	40 gallons	100000	30	0.00319	380	0.0000191	63,000	380
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.003 lb ai/gallon	40 gallons	100000	30	0.0087	140	0.0000522	23000	140
	Warehouse - C&C	0.0089 lb ai/gallon	40 gallons	29000	1100	0.00746	160	0.00568	210	**91**
				8600 (SL/G)		0.0022 (SL/G)	540			150 (SL/G + No R)
	Mounds/nests	0.062 lb ai/gallon	40 gallons	100000	30	0.18	**6.7**	0.00108	1100	**6.7**
				430 (SL/G)		0.00078 (SL/G)	1500 (SL/G)			630 (SL/G + No R)
	Residential Living Spaces (homes, apartments) - C&C	0.0089 lb ai/gallon	40 gallons	29000	1100	0.00746	160	0.00568	210	**91**
				8600 (SL/G)		0.0022 (SL/G)	540 (SL/G)			150 (SL/G + No R)

Commented [CM1]:

Commented [CM3]:

Commented [CM4]:

Table C.2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Non-Agricultural Uses of Thiamethoxam.										
Exposure Scenario	**Crop / Target Category**	**Maximum Application Rate[1]**	**Amount Handled / Area Treated[2]**	**Unit Exposures [3] (ug/lb ai) Baseline**		**Dermal**		**Inhalation**		**Total MOE (LOC = 100)[6]**
				Dermal	**Inhalation**	**Dose [4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	**Dose[4] (mg/kg-day)**	**MOE (LOC = 100)[5]**	
Mixing/Loading/ Applying Liquids with a Mechanically-pressurized Handgun	Interior landscaping	0.0011 lb ai/gallon	40 gallons	100000	30	0.00319	380	0.0000191	63,000	380
	Landscaping, trees/shrubs/bushes	0.0011 lb ai/gallon	1000 gallons	6050	8.68	0.00483	250	0.000138	8,700	240
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.228 lb ai/acre	5 acres	1140	1.9	0.000942	1300	0.0000314	38000	1300
	Warehouse	0.0089 lb ai/gallon	1000 gallons	1800	79	0.0116	100	0.0102	120	**55**
				640 (SL/G)	15.8 (PF5)	0.0041 (SL/G)	290 (SL/G)	0.0020 (PF5)	590 (PF5)	190 (SL/G + PF5)
Loader/Applicator										
Loading/Applying Granule Formulations with a Belly grinder	Landscaping, trees/shrubs/bushes	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560
	Landscaping, plants/flowers	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.264 lb ai/acre	1 acres	10000	62	0.00191	630	0.000238	5000	560
Loading/Applying Granule Formulations with a Rotary spreader	Golf course (tees and greens only)	0.264 lb ai/acre	5 acres	440	10	0.000421	2900	0.000191	6300	2000
	Golf course (fairways, tees, greens)	0.264 lb ai/acre	5 acres	440	10	0.000421	2900	0.000191	6300	2000
	Landscaping, turf (lawns, athletic fields, parks, etc.)	0.264 lb ai/acre	5 acres	440	10	0.000421	2900	0.000191	6300	2000
Loading/Applying Paint/Stain with Brush/roller	Structural (e.g., warehouses, FHE, home bathrooms)	0.0089 lb ai/gallon	5 gallons	180000	280	0.0058	210	0.000181	6600	200

1. Assessment based on maximum registered application rate for each scenario. Crops were grouped according to application rates and applicable exposure scenarios to cover all uses.
2. Based on ExpoSAC Policy 9.1.
3. Based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data).
4. Dose = Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/ gal or lb ai/A) × Area Treated or Amount Handled Daily (gal/day or A/day) ÷ BW (69 kg).

Dermal dose includes a dermal absorption factor of 5%.

5. MOE = POD (1.2 mg/kg/day) ÷ Dose (mg/kg/day). Bold MOEs represent estimates of concern (LOC = 100).
6. Total MOE = NOAEL (1.2 mg/kg/day) ÷ (Dermal Dose mg/kg/day + Inhalation Dose mg/kg/day). Bold MOEs represent estimates of concern (LOC = 100).

Table C.3. Separate Dermal and Inhalation Risk Estimates for Seed Treatment Scenarios That Do Not Reach LOC of 100 with SL/G and No Respirator When Risks are Combined.

Exposure Scenario/ Worker Activity	Application Rate (lb ai/lb seed)	Seed Treated/Planted (lb seed)	Dermal MOE (LOC = 100)			Inhalation MOE (LOC = 100)			Combined MOE
			SL/No G	SL/G	DL/G	No-R	PF5 R	PF10 R	
Corn: field (liquid formulations)									
Mixer/loader	0.0011	339,500	No Data	190	250	650	3,300	6,500	
Sewer	0.0011	339,500	710	760	1,500	970	4,800	9,700	
Bagger	0.0011	339,500	490	660	1,300	1,400	6,900	14,000	
Multiple Activities	0.0011	339,500	No Data	110	170	140	690	1,400	
Corn: Pop (liquid formulations)									**See Table C.4**
Mixer/loader	0.0026	339,500	No Data	**82**	100	280	1,400	2,800	
Sewer	0.0026	339,500	300	320	650	410	2,000	4,100	
Bagger	0.0026	339,500	210	280	540	590	2,900	5,900	
Multiple Activities	0.0026	339,500	No Data	**45**	**72**	**59**	290	590	
Corn: Sweet (liquid formulations)									
Mixer/loader	0.0025	339,500	No Data	**85**	110	290	1,400	2,900	
Sewer	0.0025	339,500	310	340	670	420	2,100	4,200	
Bagger	0.0025	339,500	210	290	560	610	3,000	6,100	
Multiple Activities	0.0025	339,500	No Data	**47**	**75**	**61**	300	610	

Table C.4. Combined (Dermal + Inhalation) Risk Estimates for Seed Treatment Scenarios That Do Not Reach LOC of 100 with SL/G and No Respirator.

Exposure Scenario/ Worker Activity	Application Rate (lb ai/lb seed)	Seed Treated/ Planted (lb seed)	Combined MOE (LOC = 100)								
			SL/No G + No-R	SL/G + No-R	DL/G + No-R	SL/No G + PF5 R	SL/G + PF5 R	DL/G + PF5 R	SL/No G + PF10 R	SL/G + PF10 R	DL/G + PF10 R
Corn: field (liquid formulations)											
Mixer/loader	0.0011	339,500	No Data	150	180	No Data	180	230	No Data	180	240
Sewer	0.0011	339,500	410	430	590	620	660	1,100	660	700	1,300
Bagger	0.0011	339,500	360	450	670	460	600	1,100	470	630	1,200
Multiple Activities	0.0011	339,500	No Data	**62**	**77**	No Data	**95**	140	No Data	100	150
Corn: Pop (liquid formulations)											
Mixer/loader	0.0026	339,500	**63**	**74**	No Data	**77**	**93**	No Data	**80**	**97**	**63**
Sewer	0.0026	339,500	180	250	260	280	490	280	300	560	180
Bagger	0.0026	339,500	190	280	200	260	460	200	270	490	190
Multiple Activities	0.0026	339,500	**26**	**32**	No Data	**39**	**58**	No Data	**42**	**64**	**26**
Corn: Sweet (liquid formulations)											
Mixer/loader	0.0025	339,500	No Data	**66**	**80**	No Data	**80**	100	No Data	**83**	110
Sewer	0.0025	339,500	180	190	260	270	290	510	290	310	580

Table C.4. Combined (Dermal + Inhalation) Risk Estimates for Seed Treatment Scenarios That Do Not Reach LOC of 100 with SL/G and No Respirator.											
Exposure Scenario/ Worker Activity	Application Rate (lb ai/lb seed)	Seed Treated/ Planted (lb seed)	Combined MOE (LOC = 100)								
			SL/No G + No-R	SL/G + No-R	DL/G + No-R	SL/No G + PF5 R	SL/G + PF5 R	DL/G + PF5 R	SL/No G + PF10 R	SL/G + PF10 R	DL/G + PF10 R
Bagger	0.0025	339,500	160	200	290	200	260	470	200	280	510
Multiple Activities	0.0025	339,500	No Data	**27**	**34**	No Data	**41**	**60**	No Data	**44**	**67**